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THE CONFLICT OF RELIGION AND SCIENCE.

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"Though all the winds of Doctrine were let loose to play upon the Earth, so Truth be in the field we do injuriously . . . to misdoubt her strength. Let her and falsehood grapple, who ever knew Truth put to the worse in a free and open encounter?"—(Milton—*Areopagitica*).

THERE are many books that deal specifically with a supposed conflict between religion and science, or with a warfare between science and dogmatic theology. It is my conviction that the view-point of most books of the sort is badly chosen, and I desire in this preface to set forth briefly the reasons for thinking that the battle has often been joined on a wrong issue. The question is fundamental and deserves a much fuller treatment than can here be given. To make it entirely clear it might be necessary to reprint one of the warfare-of-science books with a commentary, meeting every argument as it arises; exhibiting and enforcing a different point of view; and proving that the change of view-point was reasonable and necessary. Lacking the space for extended argument, it is necessary to condense it. Indulgence is asked for a presentation that must necessarily be brief, but which can very readily be made more complete.

The mass of men believe that religion has come out vanquished, humiliated and discredited from a long warfare with triumphant science. One of the very wisest of 'the martyrs of science'—Roger Bacon—has said 'what the mass of men believe is necessarily false.' The saying is harsh, and Bacon suffered for it. It is more true to say that few popular formulas are so exactly stated that a historian of science can accept them in their crude and current form. The popular doctrine as to the conflict in question undoubtedly needs amending.

Most books of the warfare-of-science sort are built more or less on the same plan. Let us take the case of the figure of the earth for an example. They often treat it in the following order: The primitive conception, that of a flat earth; early scientific ideas of its sphericity; opposition of the early church; evolution of a sacred theory drawn from the Bible; its influence on christian thought; survival of the idea of a spherical earth; contrast of the theological and scientific spirit; last outbursts of theological hostility; retreat of the church; final triumph of science over theology. Or, more briefly, their treatment may often be summarized thus: Science always right; theology always interfering; glory to us who have done away with superstition!

The real conflict of the ages has been between enlightenment and ignorance. Sometimes the battle has been in the field of theology; sometimes it has been in the field of science. The warfare has nearly always been between religion and heresy; or between science and pseudo-science; occasionally, but not very often, between religion and pseudo (or it may sometimes be true) science. Usually, however, the fields were plainly marked off. The theologians of any one epoch treated theological questions and only those. They were not even interested in scientific questions, as such. Men of science, before the time of Galileo and Bruno, did not meddle with religion. Each class kept to its own sphere.

But let us return to the question of the figure of the earth. Untutored man believed the earth to be flat; the sky to hang above it like a canopy; the stars to be fixed to the canopy (or to hang from it as the Arabs taught); the canopy to move from rising to setting, from east to west. Now, this was an entirely scientific theory. It accounted satisfactorily for every fact known to untutored man. A theory is perfect when a future phenomenon can be predicted beforehand as accurately as it can subsequently be observed. This was then, at the time, a perfect theory; it needed no apologies. Aristarchus and other Greeks saw that the observed phenomena (rising and setting of the stars) could be as well explained by a spherical earth that turned on its axis—as well, but no better. They did not know which theory was true. They had no means of deciding the point.

A matter of importance must be here alluded to. Long centuries of experience have taught us that there is one and only one solution to a scientific problem. We call such a unique solution a 'theory.' Anything less definite is a provisional 'hypothesis.' Now, the theories of the ancients were generally held by them primarily as hypotheses. Their whole attitude towards certainty was, in physical science, entirely different from ours. It has required all the centuries to teach us our lesson of implicit trust in scientific methods. Our trust is, in fact, in methods, not, primarily, in results. In general, a physical theory attributed to one of the ancients was held by him as we hold a hypothesis. It

might be so; it probably was so; but he was not ready to die for it.

The early fathers of the christian church took some one view, some another, of the shape of the earth. St. Augustine tolerated the scientific view, and said at the same time: "What concern is it to me [as a theologian, he meant] whether the heavens as a sphere enclose the earth at the middle of the world, or overhang it on either side?" It was a matter of almost no concern to the Bishop of Hippo at that time, in that place, under those conditions. The mission of the church in the fifth century was to civilize the teeming millions of pagans and barbarians. It was a mighty task. It was performed. It required the entire energy of all churchmen. It was of infinitely small importance, then, whether the barbarians were crowded together on a flat or on a spherical earth. The entire indifference of churchmen, then and later, to purely scientific matters is a fact to be kept in mind.

The theory of a flat earth was enforced from scripture in the sixth century by an Egyptian monk and traveler, Cosmas Indicopleustes. The warfare-of-science books all treat his theory as monkish (because it is wrong). But he was a great traveler and he was reputed scientific in his time. His theory agreed well enough with the simpler facts as he knew them, although it can not stand a moment in face of the facts as they are. Are we to blame him for ignorance? If so, who shall 'scape whipping? Is it a merit of ours that we happen to have been born since 1521, when Magellan's voyage of circumnavigation was completed?

The books in question tickle our vanity with a suggestion that our fortune of birth is somehow a merit. Our children 'know' that the earth is round; that England is an island. How? Because they have been told so. It rests on authority for them. Their elders have a better basis for belief. They know how to prove or to disprove these assertions. But how many of the elders can *prove* that the earth turns on its axis? It is not an easy matter, and here, in their turn, they rest on authority. How many of my readers can describe Foucault's pendulum experiment off-hand, or explain how a change of gravity with the latitude demonstrates the earth's rotation? Our predecessors in the middle ages rested on the best authority they could attain. Are they to be blamed because our centuries of experience were not behind them?

The implied conclusion of the warfare-books seems to be that our predecessors are to be blamed for lack of open-mindedness to scientific truths. Open-mindedness implies long experience. It is a product of past centuries. Until the centuries are, in fact, past, this virtue can not be evolved; nor can its opposite vice be atrophied except by time.

It is a pertinent fact that in the seventh century Isidore of Seville,

and in the eighth the venerable Bede, pronounced in favor of the earth's sphericity. After these two great doctors had spoken it was allowable for any churchman to follow them. That many did not is an incident in the warfare with ignorance, not an attack of religion upon science; and this conclusion is a point to be emphasized.

Lightfoot, vice-chancellor of the University of Cambridge, in the seventeenth century, declared that the scriptures taught that 'heaven and earth, center and circumference, were created all together, in the same instant,' and that 'this work took place and man was created by the Trinity on October 23, 4004 B. C., at nine o'clock in the morning.' It has been appositely remarked that a crowd of busy men, who had invented geometry and other sciences, were busily engaged in building pyramids in Egypt on this very October morning. The Bible does not explicitly give the foregoing, or any, date. If it did so, we might have a conflict between science and the Bible. Archbishop Usher in 1650 fixed a date by interpreting the Biblical words scientifically (not theologically). His scientific methods will not stand examination. Any modern Biblical scholar can show this. Have we here any signs of a conflict between religion and science? Not at all. In a scientific question a mistaken method was employed then, as so many times before and since. That an erroneous scientific result had a bearing on theological matters was incidental, not essential. The wild disorder of Jordano Bruno's systems of cosmic infinities, notably his guess that the stars were worlds, filled the mind of Kepler with horror. He expressly says that he shuddered with horror at the thought. It was precisely these new infinities of worlds that the Roman inquisitors found to be heretical. They had, without knowing it, the support of the great protestant astronomer. Kepler's horror for Bruno's ideas was no theological opposition. It was based on the best philosophy of the time. Like the Roman inquisitors, Kepler believed the universe to be finite. Can we wonder that the fugitive Dominican monk was tried and sentenced for heresy? Can we wonder that ideas from which the free-minded speculative Kepler recoiled were odious to a congregation of monks?

The cases so far examined are typical. Nearly every recorded instance of 'conflict' can be reduced to one or another of them. All are explicable as conflicts primarily with ignorance—and in that way alone.

Dante declared that hell was beneath the earth. Medieval textbooks answered the question: 'Why is the sun so red at sunset?' by declaring: 'because he looketh down upon hell.' This answer we know to be absurd; we even feel a flush of superiority to Dante and the middle age when the question is quoted; it is, apparently, sometimes quoted by the warfare-of-science books to produce this grateful glow; but not half the readers of this article can at once say what the

real answer is. The reply could not be completely given by any one until after the invention of the spectroscope in 1861—some forty years ago.

Copernicus taught the heliocentric theory—that the planets revolved about the sun, as we know that they do. In 1616 his books were placed upon the index, there to remain 'until corrected.' The action of the Congregation of the Index was an incident in the distressing history of Galileo. It was not taken, however, until the congregation had consulted leading astronomers and had obtained their verdict that the heliocentric theory was without foundation.* The pseudo-science of the Aristotelian professors (nearly all of whom were inimical to Galileo for personal as well as philosophical reasons) was opposed to the science of Copernicus. With this verdict in their minds it is not strange that the congregation should have proceeded against Galileo for heresy.

The system of Copernicus was proposed in 1543. It was true in its grand outlines; it was erroneous in many details. It was not *proved* till Galileo's discoveries of 1610. Tycho Brahé, the greatest authority of his time, expressly rejected it as absurd, and proposed a new system of the world in 1587. Kepler rejected Tycho's system and proposed his own first system (which was entirely erroneous) in 1597. He proposed his second system in 1609. How could theological doctors know that at last Kepler had reached the true system of the world by his glorious discoveries of 1609? His first theory was utterly without foundation. How could theologians, his contemporaries, possibly know that the second was not in like case? How could they know that he would not live to produce a third? Let us put ourselves in their place. What should we, being doctors of the church, ignorant of physical science, and profoundly indifferent to science as such, have done? Is it too much to conclude that our action would have been precisely that of the churchmen of that day? That we should have done precisely as the Romans did; as Luther, Melancthon and other protestants had earlier done? Kepler believed that all comets moved in straight lines; that the planets were sometimes repelled, sometimes attracted, by the sun; that each planet had a soul to guide it on its path; that all the planets sang together—Mercury, soprano; Venus, contralto; Mars, tenor; Jupiter and Saturn, bass. How much of all this was the church bound to accept? All of it is false. How could theological doctors possibly sift the false from the true?

The correspondence of Kepler and Galileo on the question of the tides is interesting in this connection. Kepler likens the earth to an animal, and the tides to its breathings and inbreathings, and says they follow the moon. Galileo laughs at him for this and declares that it is mere superstition to connect the moon with the tides. Ought the Roman church to have accepted Galileo's dictum?

* This fact is omitted by the warfare-of-science books.

Let us, in order to make the whole question clearer, hark back to the middle ages. Contrasts are more strongly shown in their uncertain light. The thirteenth century possessed two thoroughly complete systems of science. One of them was worked out by Albertus Magnus with profound learning and at great length. It was a presentation of all the knowledge of the ancients enriched by the observations of the author. It was full of novelties. It stimulated, interested and instructed, and was in no important respect antagonistic to the current beliefs of his time. It was expounded, too, in a manner that inspired respect and won friendly recognition. The system of Roger Bacon was, on the other hand, hardy and original. It was set forth with a harsh arrogance that offended all the minds it was intended to convince. It was filled with diatribes against the pope, the cardinals, the Franciscans, the Dominicans, the clergy, the laity. It convicted Aristotle and the ancients of many faults. It pointed out errors in the writings of the fathers of the church and in the Vulgate. It exalted the morality of heathen philosophers like Seneca above the teachings of Christian preachers. It was, of course, not free from errors of its own. How could it be?

Both Albertus Magnus and Bacon, like all the men of their time, admitted astrology to a place among the sciences. Every one agreed that the stars influenced the destinies of individual men. Bacon went further and declared that the future of religious systems depended on conjunctions of the planets; that christianity would perish at a future conjunction of the moon with Jupiter! He believed in this insane folly with just the same sincerity as in his wonderfully intelligent and essentially correct theory of the rainbow; and he enforced it with like vigor.

The originality of Bacon's mind shocked the timid opinion of his time. The harshness of his character swept the earth free of friends. The errors of his astrology gave a handle to his enemies. In this matter they were more nearly right than he. Is it any wonder that he was disciplined and imprisoned by generals of the Franciscans, whom he had attacked; that the chapters of his order fully confirmed his sentences; that the popes approved them?

Was his fate the result of a warfare between religion and science? Let us consider the question closely. The doctrines of Bacon were condemned by the church, the true doctrines along with the false. Church dignitaries chose the Dominican friar, Albertus Magnus, as their representative rather than the Franciscan friar, Roger Bacon. We, to-day, after six centuries of struggle with ignorance, know that Bacon's system, as a whole, is wonderfully original, comprehensive, correct in method, fruitful in results. We entirely forget his errors; we are amazed at his profound intelligence. Great as Albertus was in his time, we, to-day, see that his contribution to the world's ideas is

small compared with that of his rival. How could the churchmen of the thirteenth century possibly know this? It has taken six centuries for us to learn it. Bacon's *Opus Majus* was first printed in its complete form in 1897—seven years ago, six centuries after his death.

His colleagues only knew that his brilliant and profound scientific ideas were too hard for them to follow. His theory of the rainbow, for instance, was not confirmed until the time of Descartes (1630). His correct theory of the Milky Way was not proved until 1610. His doctrine of 'species'—of the radiation of energies like gravitation—was not completed so as to be generally intelligible until the time of Huyghens, Hooke and Newton (1700). His conclusion that light is not propagated instantaneously, but takes time to pass from place to place, was not confirmed until the day of Roemer (1700). His guesses at the nature of heat could not have been understood or verified till the day of Count Rumford (1790). Bacon died in the year 1294.

How were his colleagues to judge of such profundities? They could not. But in looking through his scientific works they found that he held, with equal tenacity, a conclusion which they were entirely capable of judging. He declared that at a future conjunction of the moon and Jupiter the christian religion would perish. They believed their religion to be immortal. Bacon subjected a spiritual truth to material things; a divine institution to configurations and conjunctions of the planets. The first duty of institutions, states and individuals is self-preservation. For the church to accept Bacon's conclusions was sheer suicide. They were accordingly condemned. Along with the false the true suffered. It was an immense loss to the science of the middle ages and of the world that these things so fell out. But can it be wondered at? Were they, in any strict sense, the signs of a conflict between religion and science? The science that was especially condemned was false science; it was not true; it was, moreover, an attack on the very life of the church. Is not the whole episode just one step in the laborious, painful, slow, disheartening struggle between enlightenment and error—between illumination and ignorance? Must we not interpret the melancholy history of Jordano Bruno in the same way? Science had far less at stake in his case than in that of Bacon.

It may fairly be said, that up to the time of Galileo there never was, in any true sense, a conflict between religion and science. I am not here concerned to push the inquiry beyond this date of 1615. The controversies of the nineteenth century are, perhaps, of a different nature. During the earlier centuries there were endless warfares between one religion and another, between religion and heresy, between science and pseudo-science, but not between religion and science, as such. Looking backward, we now discover that the science of the nineteenth century would have been in conflict with the theology of the thirteenth. But in the thirteenth century itself, and

in every other century, the warfare was, in general, between religion and heresy—not science; between science and pseudo-science—not religion. The distinction is fundamental. It arises from the very constitution of man and the world he lives in.

From the time when primitive man first learned to light a fire until the present instant, there has been an increasing struggle between man and external nature; between man and the immaterial ignorances of his mind, also. Little by little, by slow steps, external and material nature has been subdued or circumvented in man's pursuit of comfort. Security and leisure, with their by-products, are the mile-stones along the tortuous path. Little by little the ignorances, anxieties and fears of man's spirit have been driven out, or, it may be, circumvented (one set of disquieting illusions sometimes being replaced by another) in his pursuit of spiritual happiness. Even material comfort has not yet been attained for society at large—witness the housing of the poor, and the death rate of young children—though we are far on the road towards it.

Veritable progress has been made on the road to spiritual happiness also. The spiritual welfare of a man is bound up in his beliefs —in his religion. To attack and unsettle the beliefs of any age is to threaten its happiness in a vital spot and such attacks are always vigorously repelled. A blow directed against ideals sincerely held hurts; and is resented. That they are ignorantly held does not lighten the blow. We have, to-day, partially—and only partially—learned the lesson that if we would not stagnate in error we must welcome criticism. We have learned that a patient tolerance of criticism is one condition of progress.

The veritable conflict of the past has been between enlightenment and ignorance; between true religion (the residue left after countless onslaughts of heresy) and false; between true science (again, a residue) and pretended. The issue has been along the road that we call progress—the residue of insight and acquirement left to us after the experience of the ages. We have at last learned that even our divagations from the straight path are not all in vain; that our teaching comes through our errors. Men of genius commit their errors but once; they become our leaders because they learn more quickly; our own errors are countless, are ceaselessly committed, and it may be, in time, corrected. All that we have acquired has come direct to us from such leaders; all that the mass of men have learned is to glean the fragments the leaders let fall, and to have a patient, or it may be frivolous, tolerance of novel ideas and of suggested change. Leaders who have escaped martyrdom of one sort or another we may account unusually fortunate, or exceptionally adroit.

Looking backwards, then, over the centuries we see perpetual conflict with ignorance, perpetual struggle in both the physical and the

spiritual worlds; and specifically a struggle in one world between true and false science, in another between religion and the heresy of the time. If we survey the whole of history at a glance we see that the science of one epoch has often been at variance with the religion of another; but we also see that in each and every age the conflict has been between things of one and the same kind; between religion and its opposite, between science and its opposite; and not in general between things so different in their nature as science and religion.

The histories of the so-called 'martyrs of Science' should be interpreted in the light of the foregoing conclusions. It may be that some readers, even while admitting the argument here set down, will leave it with an uneasy feeling that it can not, after all, be correct. It differs from received opinion. It is so much at variance with the views expounded in books of the warfare-of-science sort. But *is* it? As to opinion, I will quote a phrase of Kepler's:

The whole of philosophy is nothing but innovation, and a combat with immemorial ignorance.

Kepler was in the thick of the fight and knew that of which he spoke. He blames ignorance and not religion, nor theology. As to the real teaching of the books in question, I will quote two paragraphs from President White's 'Warfare of Science with Theology in Christendom.'

I. Nothing is more unjust than to cast especial blame for all this resistance to science upon the Roman Church. The Protestant Church, though rarely able to be so severe, has been more blameworthy.

II. As to the older errors the whole civilized world was at fault, Protestant as well as Catholic. It was not the fault of Religion; it was the fault of that short-sighted linking of theological dogmas to scriptural texts, which in utter defiance of the words and works of the Blessed Founder of Christianity, narrow-minded, loud-voiced men are ever prone to substitute for Religion.

The first citation is amply proved in the book from which it is taken. The second lays the blame precisely where it belongs, namely, upon the whole civilized—that is, partly civilized—world. The conflict was the outcome of invincible ignorance; it was an episode in the progress towards enlightenment. It had nothing to do with religion —Dr. White so states. That it had nothing to do with theology will be clear when we reflect that the particular form of men's theology determined only the particular manner in which their ignorance was manifested. Catholics chose one form; Protestants another. The real cause underlaid theological form; and was the ignorance of 'narrow-minded' men. It was independent of 'scriptural texts,' though they were often quoted to serve a purpose. From Dr. White's own words it appears that the conflicts of science have not been, in general, with religion, nor yet with theology; but with the 'immemorial ignorance' of 'narrow-minded men,' recognized as the arch-enemy by Kepler, the protagonist, and recognizable all about us to-day, if we will but look.

THE GREAT WHITE PLAGUE.

By Dr. JOHN B. HUBER,
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IT is with a very real sense of melancholy that one contemplates the long death-roll of those of the world's great men and women who have succumbed untimely to the tubercle bacillus, which is and has been through countless generations by far the most potent of all death-dealing agencies. Had it not been for this detestable parasite, Bastien Le Page might have given us another Joan-of-Arc to feast our eyes upon; Rachel might for many years have continued to permeate the spirits of her audiences with the divine fire that was in her. Our navy did well enough in the 1812 war, as all the world knows; but what a rip-roaring time there would have been if John Paul Jones had lived to take a hand in it. We might be reading some more of Stephen Crane's splendid war stories; we might have had some more of Robert Louis Stevenson's delicious lace-work; Schiller might have given us another 'Song of the Bells'; we might have taken another 'Sentimental Journey' with Laurence Sterne; Henry Cuyler Bunner might have continued to delight us, and to touch our hearts; John Keats might have given us another Endymion. Had the tubercle bacillus permitted, Nevin might have vouchsafed us another 'Rosary'; von Weber another 'Euryanthe Overture'; Chopin might have dreamed another 'First Polonaise'; and the tender flute notes of Sidney Lanier might even now be heard. Maria Constantinova Bashkirtseff, Zavier Bichat, John Godman, Rene Theophile Hyacinth Laennac, Henry Purcell, John Sterling, Henry Timrod, Artemas Ward, Henry Kirk White, Henry David Thoreau, Baruch Spinoza—such names as these are but a moiety among those of the world's nobility, whose precious lives were cut off in their prime by the 'Great White Plague.'

And our sense of resentment is by no means mitigated when we reflect that this bacillus is so minute that it was reserved for Koch, in our own time, with the aid of an exquisitely high-powered microscope, to discover it, and to reveal its life history and its habits and properties. It were indeed worthy the pen of a Heine to set forth how, although our mastodons are extinct, although we easily destroy all other visible brute creation, although we hold ourselves to be world masters and universe compellers, the race has nevertheless until our generation been impotent in the presence of an organism, measuring in length one ten-thousandth of an inch and in breadth one fifty-thou-

sandth of an inch—an organism which multiplies so rapidly and so invisibly and insidiously that the consumptive, in coughing, emits several billions of it during twenty-four hours.

There would be no excuse truly for putting such sinister details as these before the laity were it not that the condition of things, which we term consumption or tuberculosis, is a tremendous, much-pervading human factor. I have intimated that of all death-dealing agencies, Koch's bacillus claims the greatest number of victims; the cholera, typhus, the plague of the middle ages, small-pox—are not in the running with consumption. The last, although its ravages have not been so picturesquely gruesome, has claimed many more victims than any of the others; it has probably been coeval with human existence, and very likely has afflicted our primordial ancestors.

To-day every third or fourth adult dies of consumption. In the periods between birth and senescence every seventh death is caused by it. The point about these two propositions is this: Very few of us die only of old age; almost every one dies of one disease or another, so that it would not seem to matter much what the particular disease might be that would carry us off. But, although all periods of life are precious—infancy and childhood and old age, as well as any other —it is during adult life that consumption gets in its fell work, in the periods when young people should entertain wholesome anticipations of matrimony, when husbands should be strong to work for and maintain their families, when wives should have strength to rear their children, and when men and women generally should have physical and mental capacity so that they may accomplish the world's work.

No one knows better than the physician how truly touching may be the condition of things we are considering at the first of these periods—the period of early manhood and womanhood, when poetry, music, flowers, sunshine, and the new-born instinct to love and power to inspire love, are gloriously dominant, when sentiments ring true, when thoughts of compromise with unworthy factors, of subordinating ideals to considerations of interest, have not yet been conceived; when the love exists which welcomes sacrifices and feels that if it is ever to manifest itself, it should do so most gladly and most abundantly when the beloved is sorely stricken; the love that feels bound to triumph over all obstacles, and which snaps its fingers contemptuously in the face of fate. One is proud for human nature when such spirit is exhibited. Nevertheless it is then that this dreadful disease demands with deplorable frequency to be reckoned with. And it is then that the mature physician discerns the practical certainty that marriage, in cases where consumption exists or is suspected, will be followed by intensified illness, and perhaps death (which might not otherwise have occurred), on the part of the sick one; the possibility of infection of

the healthy mate; the likelihood of unhealthy offspring, or of its early and perhaps—under the circumstances—fortunate death; and other indications suggesting disaster at the very beginning of married life, when all the circumstances, if any time in life ever required it, should be favorable and founded upon virility of mind and body.

The tubercle bacillus gets into the body either with the air we breathe, or with tuberculous food-stuffs, or rarely through wounds. Wherever it implants itself an inflammation may occur about it, with the result that a tubercle is formed (*tuber* is Latin for root or bulb). This tubercle is in size from that of a millet seed to a hickory nut or larger. Its development is called tuberculosis. Under favorable circumstances it becomes surrounded by fibrous tissue, somewhat like the scar which would follow a wound of the skin; and then the tubercle will be comparatively harmless to the organism. However, 'cheesy degeneration' may result, two or several adjacent tubercles may break down together, a cavity may form, containing purulent material in which, on being coughed up, the bacilli are discerned by the microscope. These bacilli and these tubercles may exist in any part of the body—the skin, the bones, the joints, the lymph glands. And they, or the products of their disintegration, may be carried by the lymph and blood channels to other parts; and it is probable that in many cases the pulmonary type of tuberculosis is not originally a lesion of the lung tissue, but a product transferred from a point of implantation elsewhere.

If tuberculosis does not undergo fibrosis it is likely to be developed, through the agency of some acute 'predisposing cause,' into the complex of symptoms which we term consumption. Those thus afflicted become progressively very weak and very much emaciated. Their hearts beat rapidly and they are apt to have a pink flush on their cheeks, which is quite unlike the blush of a healthy person, but which is in reality an indication of the fever that is consuming them. The rest of their faces is very pale and thin and is suffused with a clammy sweat. Their cheek bones are prominent. And their eyes have a quite unnatural brilliancy, seeming large and beautiful. But their luster is not of health—rather of disease and too often of death. It is such eyes that the poet Bryant has portrayed in a touching and melancholy sonnet. And the consumptive spits blood sometimes, and is short of breath, and has a persistent, hacking cough, that harasses him dreadfully, and does not let him rest.

The reader is now likely to wonder how, with all these teeming billions of bacilli about, any one ever escapes the disease. The fact is, the bacillus allows very few of us to die without leaving some trace of its activity in our system. *Jeder Mensch hat am Ende ein bischen Tuberculose,* as Naegali demonstrated in 98 per cent. of the bodies

which he examined on autopsy, of people who had died of all sorts of disease, besides those dying of old age.

There are two conditions essential to the development of consumption. In the first place, there must be the presence of the bacilli of Koch as its specific or essential cause. In the second place, the body must be predisposed to the disease by various unhealthful factors, such as vicious heredity, alcoholism, poverty and the like. Most of us are able to resist the bacillus because our bodies are sufficiently strong to resist the organism, and because there are in our tissues certain germicidal properties, which are ordinarily sufficient to cope with and destroy the bacillus. The layman will easily get the idea from the following experiment: Some rabbits were inoculated with tubercle bacilli and placed in relations generally deleterious to health; these became consumptive. Another group, selected from these same rabbits, were likewise confined, but were not subjected to infection, and these did not develop the disease. Whilst among a third group, which were inoculated like the first, but which were, on the contrary, favorably located as to hygiene, most of the rabbits escaped the disease.

The tubercle bacillus is indeed originally a saprophyte, feeding upon dead or decomposing material. Its next congenial habitat is such tissue of living animals as has been previously devitalized by unwholesome factors; that is to say, these factors have rendered the tissues of the body vulnerable to the onset of the bacillus and certain other microorganisms which later join it in its work of devastation. These predisposing factors render the tissues a fruitful soil in which the bacillus and its allies may germinate and thrive. I should like to touch briefly upon certain of these predispositions.

It was formerly held that consumption is a hereditary disease. But we know now it is practically impossible for such to be the case, for parents can not transmit the bacillus to their offspring. What parents *may* transmit is a tendency to the disease, resulting from unhealthful conditions in their own organisms. Such hereditary transmission may be manifested by the offspring in the scrofulous temperament. The child may have a pallid skin and flabby flesh; and inflammation of the mucous membranes, as would be indicated by reddened and suffused eyelids, coryza and congested and unhealthy throats. There would be adenoid growths in the back of the nose and enlarged tonsils, so that such children would be mouth breathers, starved for oxygen. The glands of the neck and in other parts of the body would become enlarged. Besides these things, there might be malformations of the thorax and a capacity for breathing evidently below the average, congenital affection of the heart and the rest of the circulatory system, slow teething and deficient and tardy ossification. There would, in short, be evidence of defective development and of a generally torpid condition of the system.

It is easily to be comprehended how tuberculosis can become engrafted upon such an organism. The French government has grappled most nobly with the problem indicated in this state of affairs. It has established in various parts of France hospitals for tuberculous children, many of whom are no doubt only scrofulous. Several of these institutions are on the sea coast, at Berck-sur-Mer and at Hendaye; and the children are assured the benefit of the sea air, and of ozone, lots of sunshine, plenty of pure food-stuffs—bread, meats, milk and eggs; careful nursing; and excellent medical care of their 'white swellings' of the joints, tuberculous affections of bones, and of the many other conditions requiring the physician's attention. Thus, instead of early deaths, or of the prospect of growing up weaklings, many of these children are vouchsafed happy lives and strong constitutions, thereafter resistant to infection, and have inculcated in them habits of cleanliness and hygiene which they are sure to disseminate after their graduation. In this manner there are secured to the state many worthy and splendid citizens who would otherwise be lost to it. It is really a movement worth the consideration of the political economist.

Excessive alcholism stands in a causative relation to tuberculosis because of the resulting tissue impoverishment. The pulmonary type is almost invariably found in persons dying in the course of chronic alcholism. *'L'alcoolisme fait le lit de la tuberculose,'* states the physician, Landouzy.

It is difficult to explain the effects of alcohol. Like most of the simplest things in life, no definite agreement has ever been reached concerning its mode of working. It is evident, for instance, that there is no hardier stock than the wine-drinking countries; and it would seem that alcoholic fluids that are of good quality and purity, and are taken temperately, are conducive generally to health.

In all likelihood the bad effects fairly attributable to alcohol lie largely in the vicious quality of what is consumed, and in the state of affairs which it connotes: unsanitary habits, poverty, lack of nutrition or bad food, ill-ventilated living rooms; and, most of all, a condition of the organism exhausted by overwork, in which the reserve force is all that is left to carry on the struggle for existence. We may imagine a man in whom the tidal strength, such as we use in dealing with the ordinary affairs of life, is gone, and who has to depend upon his reserve strength to cope with an extraordinary difficulty which would overwhelm him, but for which, if we had to deal with it, our reserve strength would be altogether adequate. Such a man is in the condition of the camel to whom the last straw is fatal. So alcohol is oftentimes taken first with a view to keeping a defective organism up to the working point, perhaps in a tuberculous subject, or in one in whom all the conditions are receptive to tuberculosis; alcohol is then taken in

increasing amounts to stimulate the flagging energies, thus making a bad matter worse. Some who contract the disease in this way have occupations directly conducive to alcoholism, such as workers in the liquor trade, barmen, waiters and hotel servants, people who are thus employed because they are, from their physical and moral make-up, 'unfit' (as the evolutionist might say) for another and a better sort of work.

Poverty, with all that the word implies—underfeeding, deficiency of sunlight, defective ventilation, overcrowding, uncleanliness, bad drainage, rank-smelling and damp-walled houses—stands enormously in a causative relation. There are plenty of data to demonstrate that tuberculosis is preeminently a disease of humanity's submerged strata.

It was estimated in Hamburg, for instance, among the several income tax classes (inclusive of the dependents of the tax-payers) that for incomes of from nine to twelve hundred Marks the death rate from consumption is 55.4; for incomes of from twenty-five to fifty thousand Marks the death rate is 7.5—a proportion against the poorer classes of nearly eight to one.

One may grasp the idea in a glance upon the maps of New York City districts which its Health Board has prepared under the medical directorship of Dr. Herman M. Biggs. By far the greatest number of our consumptives are in the poorer districts; eleven of them, for instance, dying in one year in a house in the 'lung block.' Instructive, too, are the thousand odd photographs which the New York City Tenement House Department has taken during the two years just passed, showing air shafts twelve inches wide and six stories deep; more than 360,000 'dark rooms' whose only means of ventilation, if they have any ventilation at all, is through such air shafts. Enlightening, too, is Mr. Ernest Poole's brochure on 'The Plague in its Stronghold.' Such grim humor as the following may also have illuminative value: Three families occupied an apartment of three rooms, one living in the front room, another in the rear room, the third in the middle room; and they all got along very well together until the family in the middle room wanted to take in boarders.

Besides these predispositions to tuberculosis there are many others. There are the family relations. If one member is consumptive, his sputum may in various ways be infective. It may be spat upon the floor, and if there is an infant, it will, in playing about, pick up bacillus-laden objects and, after the habit of infants, put them in its mouth. Then after weeks or months the child becomes tuberculous. So that on such accounts as these it was formerly considered that the disease itself was of hereditary origin. Then 'neglected colds,' fevers and exhausting diseases, such as typhoid or malaria, enervate the body and make it a fruitful soil for microbic germination. Direct injury,

or open wounds, or the shock occasioned by injury, or depressing emotions generally, may predispose. There are many trades which may stand in a causative relation to tuberculosis. In the excellent book entitled 'Dangerous Trades' there are nearly sixty such occupations specifically considered.

It were impossible even to mention all conditions which might predispose to consumption. For we are told that living itself is but the body's response to environmental stimuli, either physical or chemical in character; and such are about as numerous as there are external phenomena. For my part, I would reserve the opinion that the whole of life is by no means comprehended in this tenet; still it is valid as denoting the innumerable agencies, which may make the organism receptive to tubercular infection.

May we then hope to fight tuberculosis with any measure of success? Yes, indeed. To do so, two objects must be kept in view: We must destroy the bacillus; and we must render the organism of the individual resistant to infection. The disposition of the tubercle bacillus is theoretically extremely simple. Tuberculosis as an infectious disease is totally unlike certain others, as, for instance, diphtheria or scarlet fever. One can not be sure, after having been half an hour in the same room with a diphtheria patient, that he will not contract the disease. If, however, certain very elementary precautions are taken, one may live with a consumptive for months or years without jeopardizing his health. It has been truly said that there is no place where one is less likely to contract consumption than in a scientifically conducted sanitarium for consumptives. For instance, all the dust in one of Dr. Trudeau's cottages at Saranac Lake was gathered together, and a culture made from it; and this culture, when injected into a guinea pig, was not sufficient to give this little creature tuberculosis. And we may observe, in passing, that consumptives, who have been cured in such institutions, go out as well-trained medical missionaries, teaching others the habits of sanitation and cleanliness they have accustomed themselves to. Nor is any other community likely to be as healthy as one in which such a sanitarium is situated.

The sputum of the consumptive must be destroyed; and our government inspectors must see to it that no tuberculous meat and milk gets into our markets. These are practically the only sources of tubercular infection we need fear, and if these things were thoroughly attended to, there would be no danger of infection.

There are many, indeed, who have in this direction an unnecessary and not altogether dignified dread. For instance, some time ago a young woman left New York City for the west. She was of splendid intellectual capacity, amiable, gentlewomanly and withal of an exquisitely sensitive nature. She had little means; and, in order to

travel as cheaply as possible, she took a slow train, let us say, on a Monday evening. She reached her destination late on Wednesday afternoon, very much exhausted and very ill. Although almost six feet tall, she weighed, before going, just ninety-seven pounds. She had the lustrous eyes and the pink flush associated with consumption; her pale face was suffused with a cold, clammy sweat; and she had the cruel cough, which wracked her chest and would not let her rest. The first thing she did was to go to a home for young women, where she asked to stay over night, so that in the morning she could go to the sanitarium where her stay had been arranged for. They would not take her in. It was their rule to refuse consumptives, even for a night; and with the name of the 'Poor Nazarene' over their door, they turned her away.

The reader, if he have read only this paper, will now see that there was no occasion for this. We might dilate upon the spirit of Christliness, to which this institution would ostensibly lay claim, and through which spirit this very sick traveler might surely have been given shelter until the morning at least. But upon a purely practical basis, there is no reason why, with elementary knowledge and common sense, such as those controlling such an institution should have, this sick one could not have been provided for without in the least jeopardizing the health of any other person. The progress of civilization is never furthered, indeed it is most horribly retarded, whenever the stigma of inhumanity is fixed upon the fair countenance of religion.

THE DISCOVERY OF THE NATIVE HOME OF THE SAN JOSE SCALE IN EASTERN CHINA AND THE IMPORTATION OF ITS NATURAL ENEMY.

By C. L. MARLATT,
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THE insect which has had the greatest international importance and has been the subject of more interstate and foreign legislation than all the other insect enemies of plants together is a Chinese bark-louse of deciduous trees, known from its first point of colonization in America as the San Jose scale. This insect has been so thoroughly exploited in the publications, scientific and popular, in this country, and in horticultural and agricultural journals, that a general account of it is not necessary. It was first discovered in San Jose, Cal., in the grounds of Mr. James Lick, in the early seventies. It soon spread throughout California and the Pacific coast and became the most notable enemy of such fruits as the pear, apple, peach, prune and certain small fruits. Its name of *perniciosus* was given it by Professor Comstock, who studied it in California in 1880 and reported it to be the most destructive scale enemy of fruits known to him. It has more than maintained its reputation in this regard since that time.

Up to 1893 it was only known on the Pacific coast, but in that year it was discovered in a small orchard in Virginia, and the investigation which followed developed the fact that it had got into some large eastern nurseries a number of years before on plum trees from California, and had been spread from these nurseries unwittingly over much of the southern and eastern states. The damage which soon developed from this scale insect in the orchards of peach, pear and apple of the east aroused very considerable excitement, and the alarm thus caused was transmitted to foreign countries with the result that, beginning with Germany, one after another of the European powers adopted measures prohibiting the importation of American plants and fruits, or requiring rigid inspection before such admission. Canada adopted similar restrictions, and even such remote countries as the Cape of Good Hope, New Zealand and Java followed suit. Within the different states of the union also various prohibitions on traffic in nursery stock and plants were put in operation. Since 1893 this scale insect has steadily extended its range in the United States and also in Canada, where it soon gained foothold, and it now occurs in practically all the important fruit districts of North America. It has not

gained lodgment in Europe so far, and the chances are that if it should do so the climate of Europe is so unfavorable that it would not be nearly so mischievous there as in America.

The explorations, which are briefly narrated in this paper, were undertaken to discover the native home of this scale insect, which was, prior to 1901, a mere matter of conjecture. The desirability of discovering the origin of this scale pest arose from the now well-known fact that wherever an insect is native it is normally kept in check by some natural means, and as a rule by some predaceous or parasitic enemy. In the chance importation of foreign destructive insects to our shores it very often happens that the natural check or enemy is left behind, and the imported pest becomes in consequence much more injurious here than in its native place. In a number of notable instances in this country very great benefit has been derived by the discovery and introduction of such natural enemies, thus reproducing the conditions which obtain in the native home of the injurious insect. The fluted scale and the Australian ladybird in California is the most notable instance. The importation of this ladybird from Australia has made citrus growing possible in California, and saves annually many millions of dollars to that state. This and other similar cases indicated the desirability of discovering the native home of the San Jose scale, and the importation, if possible, of whatever natural means were found there keeping it in check.

Prior to this investigation there was a pretty well founded belief, shared by Dr. Howard and the writer, that the San Jose scale was a native of eastern Asia. Without going into detail, this belief was based chiefly on the ground that most other quarters of the world had been fairly well investigated without any evidence of this scale insect being found. It was known to occur in Japan, but the evidence rather indicated that it had been recently brought to that country from the United States in connection with the large shipments of nursery stock from California to Japan during the last twenty-five or thirty years. The itinerary, therefore, planned by the writer, with the advice of the chief entomologist of the Department of Agriculture, Dr. L. O. Howard, was to include Japan, China and any other countries in eastern Asia which it should prove desirable to visit. Six months were devoted to a very thorough exploration of the different islands of the Japanese empire, and three months to China, with shorter periods in other regions. The explorations in China and Japan are the only ones which bear especially on the San Jose scale problem.

Explorations in Japan.

During the time spent in Japan, from April to September, 1901, the writer visited some forty-two provinces, and explored all the prin-

cipal islands, representing a stretch in latitude the equivalent of from northern Maine to Florida. Altogether these explorations enabled him to make a pretty correct judgment on the San Jose scale problem in Japan. Japan is not especially a horticultural country. Her comparatively enormous population of 46,000,000 compels the growth of cereals and other necessities of life wherever possible. Very little land, therefore, is devoted to fruit raising, and fruits are considered as luxuries. Nevertheless, practically every dwelling house in Japan has a little dooryard or kitchen garden in which are single examples of cherry, plum, peach, persimmon and other trees. Furthermore, the roadways and temple grounds and streets are lined with cherry and plum trees, planted for bloom and ornament and not for fruit. There are orchard districts in Japan of limited extent. In northern and central Japan there are a few peach orchards and a few orchards of native pears, and in southern Japan, small orchards of orange, pomelo, walnut and other fruits. In old Japan the chief deciduous fruit is a native pear grown in small patches of from a fraction of an acre to two or three acres in extent. These are trained low on overhead trellises, and at a short distance look like vineyards. There are several districts where such orchards occur in considerable numbers. These orchards are very ancient, many of them having trees more than one hundred years old. If the San Jose scale were native to Japan it would occur in these pear orchards, the pear being one of the favorite food plants of this scale insect.

METHOD OF TRAINING OLD PEAR ORCHARDS IN JAPAN (height of trellis 5 feet).

In northern Japan, including the island of Hokkaido, and the northern end of the main island, Hondo, apple raising has been introduced in modern times very much on the lines of this country. Prior to the opening of Japan to foreign commerce and exploration, the apple as an edible fruit was unknown in that country. The orchards in northern Japan are chiefly, therefore, of American origin and rep-

resent American varieties. Most of the stock came from California, and much of it was undoubtedly infested with San Jose scale when it was received. There is, therefore, throughout these northern apple orchards, a mild infestation with this scale. The Japanese are very enthusiastic in their efforts to gain all the benefits of western civilization, and this is shown in horticultural as well as in other fields. The three leading nurseries, therefore, of Japan have been very active during the last twenty or thirty years in importing the different varieties of pear, peach and apple from America, and all three of these nursery districts have become infested with San Jose scale, evidently from such importations from California, where the scale has been widely distributed for thirty years. Outside these nurseries, however, in central and southern Japan, the San Jose scale did not occur, except where it had been introduced on new stock from the nurseries referred to. The old native pear orchards were free from scale, except where replants had been made of American varieties, or new native stock, to fill in breaks in the orchards. The infestation was very often just beginning and immediately surrounded the replants. In all Japan, therefore, in the little house gardens and temple grounds where were cherry, plum and other trees suitable for San Jose scale, this insect did not occur, except where the evidence was very plain of its recent introduction as indicated. Without going into details of the evidence, it is sufficient to say that the conditions in Japan are essentially the same as in this country. The San Jose scale is a recent comer. It was, in fact, not known in Japan prior to the year 1897, when its presence there was first determined, but it has now been scattered pretty widely by nursery stock, exactly as in this country, and occurs under similar conditions; in other words, only where it has been recently introduced. The investigation showed very distinctly that Japan could not be considered responsible for the San Jose scale.

Explorations in China.

Investigations up to this point, while freeing Japan from the onus of giving the San Jose scale to the world, left the problem unsettled as to the original home of this insect. China remained as the most likely place of origin, and the writer proceeded to China to continue his explorations there. While in Japan a good deal of information was gained relative to fruit conditions in China, from English, German and American residents who were spending the summer months in Japan to escape the rather trying climate of China. In brief, it may be stated that deciduous fruits are grown from the Shanghai region northward, the peach being practically the only fruit grown to any extent about Shanghai. The great apple district of

China is the region lying back of the city of Chifu in the north. This apple-growing industry was started many years ago by a missionary, Dr. Nevius, and has assumed very considerable proportions and covers a good deal of the province of Shantung. Below Shanghai, the orange and other subtropical fruits replace the deciduous varieties. North of Chifu native fruits only are grown, consisting of the native pear and peach, and such wild fruits as wild crab apples and an edible haw apple.

A very considerable exploration of the country lying immediately back of Shanghai was made in the course of a long house-boat trip. A

A NATIVE FRUIT STAND IN CHIFU, CHINA.

great many peach orchards were examined and a good deal of miscellaneous fruit and other plants growing about house yards were inspected. Nowhere was there any evidence of the San Jose scale, nor were scale insects of any sort much to be seen. The climate of this region is unfavorable for such insects and they are normally killed out by fungous disease. The writer afterwards proceeded by boat to Chifu —a five-day ocean trip from Shanghai, and made a considerable exploration throughout the apple orchards of this region on horseback, visiting, among others, the original orchards planted by Dr. Nevius. In all these the San Jose scale was found scatteringly present, not, however, doing any special damage, and probably not enough to be

noticed, if its possibility for evil was not so well established. The presence of the San Jose scale in this region did not, however, have any special significance, since much of the original stock was obtained from California, and doubtless from nurseries which were infested with the scale.

The journey of exploration was continued northward to Tiensin and Pekin. In this region the San Jose scale was also found on native plants, including the flowering peach, a tree grown for ornament solely, and not for fruit, and notably on the native fruits in the markets in these cities.

PONY FRUIT CART IN WHICH PRODUCTS OF THE HILL COUNTRY ARE BROUGHT INTO PEKIN, CHINA.

The markets of Pekin were of especial interest in this connection. Pekin is the center and market for all the region lying to the north and west, and the streets devoted to the sale of fruits and other products in the Chinese city are one of the great show places. The fruit and nut products are brought into Pekin in little two-wheeled carts, or more generally on camelback, great caravans of heavily loaded camels and streams of carts constantly entering the city with the products of the outlying provinces. One finds, therefore, in the markets of the Chinese city the fruit products of all northern China, and can study them at ease. All the district lying between Pekin

and the great wall, north, and west, and east, has been most carefully explored and mapped by the foreign military authorities. From various individuals employed in this minute survey a great deal was learned relative to the fruit growing in the district indicated. Much of the fruit found in the markets of Pekin comes from the hill region leading up to the mountains separating China from Mongolia and Manchuria. These fruits are native apples, pears and peaches, and the little haw apple already mentioned. Great quantities of these fruits were examined in the market, with the exception of the peach, which

PORTION OF WHOLESALE FRUIT AND NUT STREET IN PEKIN, CHINA, SHOWING NUT PRODUCTS CHIEFLY PEANUTS.

was then out of season, and later similar examinations were made at Tiensin. A very scanty but general infestation with San Jose scale was found on the different fruits examined. Perhaps one apple in a hundred would have a few of these scales about the blossom end and the same proportion was true of the haw apple and the native pear. Throughout the region where these fruits are grown, there has been no introduction of foreign stock. The occurrence of the San Jose scale on these two fruits was conclusive evidence that in the region whence it came the San Jose scale is native. The scattering occurrence of the scale also indicated, as would be anticipated, that this pest in its native home is kept in check by natural means.

The investigations made at Shanghai, and later southward to Hong-

kong, the Malay Peninsula and Java, indicated that the San Jose scale in eastern Asia can not survive below Shanghai.

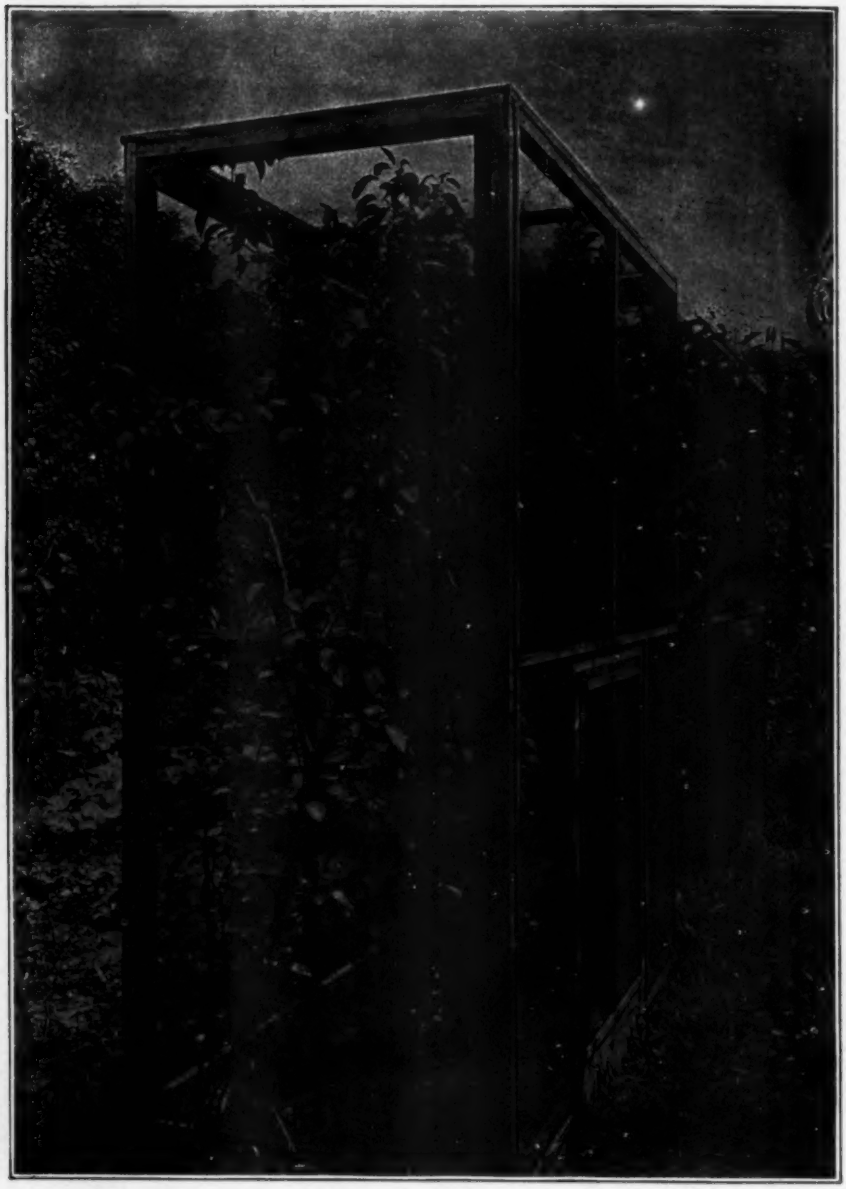
The special district where it is native and thrives is a fairly well shut off region, which probably accounts for the failure of this insect to become a world pest ages ago. This district is the region leading up to the mountains and comprising the northern and northeastern frontiers of China proper. Beyond the great wall on the north and west lies Mongolia, consisting chiefly of the vast Desert of Gobi. To the northeast and separating the region from Manchuria and Corea is

PORTION OF STREET DEVOTED TO SALE OF FRUITS IN PEKIN, CHINA.
[In foreground, fruit samples; in background, storehouses, also dromedaries employed to bring products from remote provinces.]

the eastern Gobi desert. To the south and east lies the great alluvial plain, the product of centuries of mud carried down by the Yellow River, a region where cereals only are grown. These are all effective barriers, and especially so when considered in connection with the political conditions of the past. We have, therefore, as the original home of this insect a naturally shut-off area from which it could not easily escape under the conditions prevailing up to our own times.

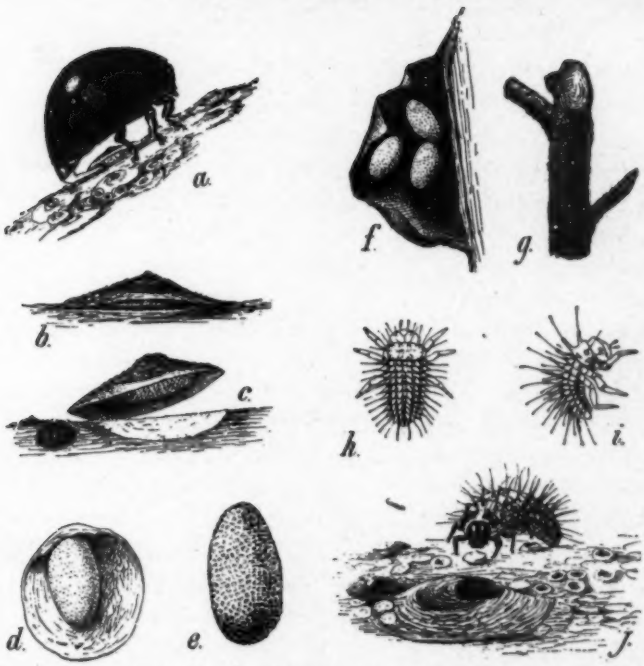
The means by which the San Jose scale came from China to America is a matter of interest. This pest reached California on trees imported by the late James Lick, a gentleman who was an enthusiastic

horticulturist and an energetic importer of plants from foreign countries. It is the writer's belief that Mr. Lick imported from China,

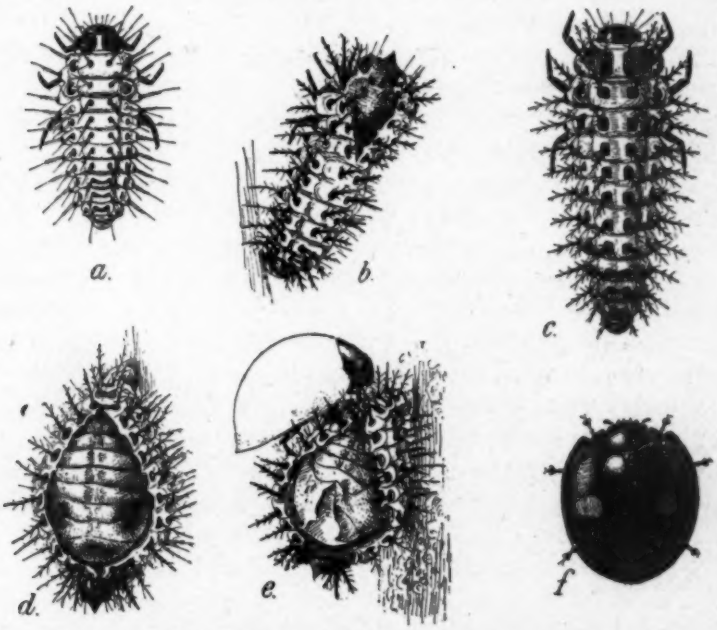


CAGES USED IN BREEDING ASIATIC LADYBIRDS (*Chilocorus similis*).

possibly through Dr. Nevius, with whom he was probably in correspondence, the flowering Chinese peach, and brought with it the San



ASIATIC LADYBIRD (*Chilocorus similis*), oviposition and early larval stages: *a*, beetle in act of thrusting egg beneath scale; *b*, scale slightly raised, showing edge of egg beneath; *c*, scale lifted from bark, showing manner of attachment of egg to the inner surface; *d*, view of egg in the scale; *e*, egg magnified to show sculpturing; *f*, three eggs placed under flap of bark; *g*, same, natural size; *h*, *i*, dorsal and lateral views of newly hatched larva; *j*, larva, first stage, feeding on mature and young scales—all enlarged except *g*.



ASIATIC LADYBIRD (*Chilocorus similis*), later larval stages, pupa, and adult insect: *a*, second larval stage; *b*, cast skin of same; *c*, full-grown larva; *d*, method of pupation, the pupa being retained in split larval skin; *e*, newly emerged adult not yet colored; *f*, fully colored and perfect adult—all enlarged to the same scale.

Jose scale to his premises. Undoubtedly this scale insect came to this country in some such way on ornamental stock from North China.

The Asiatic Ladybird, the Natural Enemy of the San Jose Scale.

Throughout the region investigated in China where the San Jose scale occurs the natural agency keeping the scale in check was evidently a small ladybird (*Chilocorus similis*), which was feeding voraciously upon it wherever the scale was found in any numbers. A considerable quantity of these beetles was collected in both Japan and China and sent by mail to Washington. Unfortunately, most of the specimens died in transit or during the first winter. Two individuals, however, survived, and during the first summer from these two some five thousand or more beetles were secured. The original stock was kept in cages, but later on the insects were liberated in an experimental orchard attached to the insectary of the department. During the first summer a considerable number of colonies were sent out to various states placing them in charge, in the main, of the entomologists connected with the state experiment stations. During the summer of 1903, the second one since the introduction of this insect, some thirty or forty additional colonies were distributed. A good many of these colonies were liberated under rather unfavorable conditions, and the beetles probably perished. The best success has come from certain colonies sent to Georgia. One of these, located at Marshallville, presents a most satisfactory outcome. This orchard contains some 17,000 peach trees, covering about 85 acres, and has lying immediately adjoining it a much larger orchard belonging to the same owner, containing 250,000 trees, all scatteringly infested with scale. The ladybirds were liberated in August, 1902, in the smaller orchard. An examination of this orchard in July, 1903, indicated that the beetles were rapidly spreading and that they would soon cover the smaller orchard. A rough estimate at this time of the number of ladybirds in all stages places the total at somewhere between 25,000 and 40,000. In Georgia the beetles evidently continued breeding up to January. There is, therefore, in this orchard at least, a very flattering outlook for good results from the imported beetle. Other colonies placed where there were only two or three or but a few trees have not yielded very satisfactory results. This outcome is not especially surprising, as under such circumstances the beetles are very apt to fly away and become lost. We are endeavoring, therefore, to place colonies where there are rather large bodies of trees infested with scales. After the beetle becomes once well established, distribution can be more general, but until this end is reached it is probably wiser not to waste material in sending specimens for colonization to small orchards or gardens or for liberation on a few trees. In Japan and China where the *Chilocorus* occurs rather generally, it finds food for itself in every dooryard, the white

peach scale being very widely distributed in those countries and the San Jose scale also in northern China and portions of Japan. In this country, on the other hand, the San Jose scale is practically its only host insect, and in spite of the wide dissemination of the San Jose scale, it still occurs after all in a very scattering way in orchards here and there, with often twenty or thirty miles between places of infestation. This imported insect can not, therefore, multiply and extend itself as rapidly and naturally as would be the case if the San Jose scale occurred more generally. For this reason it will be necessary to distribute the imported beetle artificially for some time. In Georgia, Alabama and other regions where there are general orchard districts it will undoubtedly be able to take hold much better than it will in regions where orchards are more scattering and of smaller area. Ultimately it is hoped that it will become established in America and have the same beneficial action which it now has in China and Japan. It probably will not be a complete remedy for the San Jose scale for the reasons already indicated, but if it will keep the San Jose scale in check as much as it does in its native country it will be of very decided service. One of its chief advantages will be the fact that it ultimately will take hold of the scale in many small orchards and gardens, the owners of which would be indifferent and would not undertake remedial operations, and thus furnish centers for additional reinfestation.

The importation of this insect can not work anything but good. It feeds only on scale insects, and ultimately may feed on certain of our native species as well as on the San Jose scale. It is a most voracious feeder, and has been observed to eat as many as five or six scale insects a minute, and even an average of but one a minute would give a total of 1,440 scale insects destroyed per day. The appetite of the larva seems never to be satisfied, and it is eating practically all the time. The adults also feed actively on the scale.

The chief drawback to this importation is the fact that several of our native predaceous insects have at once acquired a rather decided liking for the larvæ of the *Chilocorus*. A parasitic insect of our native ladybirds has also been attacking it in considerable numbers. These predaceous and parasitic insects may be sufficient to prevent this imported ladybird from giving the benefits which it ought. They have been especially in evidence in the Washington colony, but do not seem to have done any considerable damage in the more southern colonies referred to, and it may be that the ladybird will not suffer materially from them.

SAVING THE MISSISSIPPI'S SOURCE.

By H. M. KINGERY,
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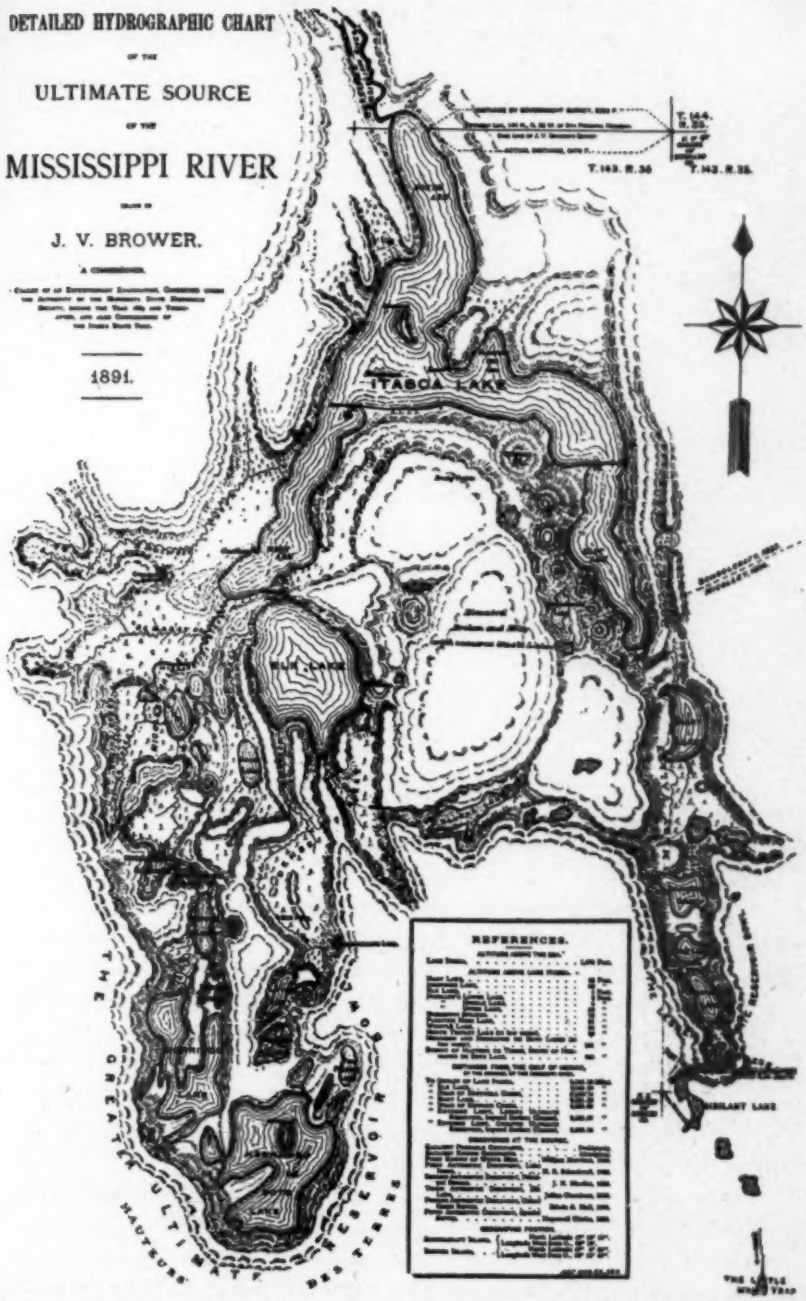
THE true American takes an honest pride in recounting the natural features of our country—its mountains, plains, lakes, rivers, cataracts, trees—all, in Yankee parlance, 'the greatest things on earth.' Of them all none is more truly worthy of admiration than the great river which practically spans our territory from north to south, draining an inland empire on its way. My vacation trip last summer took me to its source, and it is of this, with the peril that has threatened it and the measures taken to avert the peril, that I wish to tell briefly in this article.

We need not enter upon the vexed question as to what and where the real source is. Every explorer has found some new lake or river or spring which by ingenious definition he could make out to be the 'original and only' beginning of the Mississippi. Schoolcraft and the schoolboy agree in saying it is Lake Itasca; but there are streams entering that lake which if followed to their source would increase by a mile or two the total length of the 'Father of Waters,' and so satisfy more fully our national taste for bigness. The largest of these affluents is the 'Infant Mississippi,' discovered and named in 1836 by Jean Nicollet; but claims are made also for Mary river and lake, for Elk Lake and its tiny outlet, for the Mississippi springs, and for Hernando de Soto Lake. The truth is that each of these contributes its quota to the making of the Mississippi, while Itasca is the reservoir in which all their contributions are assembled. To the geographer it is a most interesting region, close to the watershed whence flow streams of widely different destination. The cook of a surveyors' camp located on this watershed used to boast that he could throw his dishwater to the left and send it to the Arctic Ocean, or to the right and start it towards the Gulf of Mexico. Not far away rise other streams whose waters find their way to Lake Superior and so to the Gulf of St. Lawrence. This peculiar configuration was known to the early French explorers, who gave the group of low hills the expressive title 'Hauteurs des Terres.'

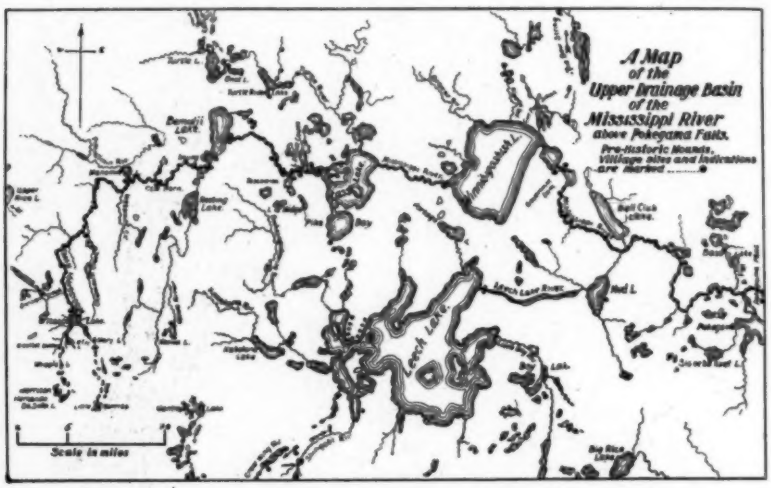
Lake Itasca lies in a valley of irregular horseshoe shape, encircled by a range of low hills, and is the largest of a considerable number of lakes in the same depression. Its form is most peculiar (as may be seen by a reference to the accompanying map); and it was doubtless



this peculiar shape, rudely resembling an elk's head with nose to the north and horns branching out towards the south, that suggested to the Indians the name they gave it—Elk Lake, translated by the French

into Lac la Biche. The present name is said to have been the joint production of Schoolcraft and the Rev. Dr. Boutwell, who were the first white men to seek this lake as the Mississippi's source. Desiring to hail it at first sight with an appropriate title, Schoolcraft asked his companion for the Greek or Latin words meaning the true source of a river. Though somewhat rusty in his classics, the reverend explorer finally recalled the two Latin words *veritas caput*—truth head. These

PLATE IV.



MAP OF THE MISSISSIPPI BASIN ABOVE POKEGAMA FALLS.

were written down, the first and last syllables crossed out, and presto! the name Itasca. The former designation, Elk Lake, is now applied to the largest of the tributary lakes.

The single island in Itasca is called Schoolcraft, in honor of the pioneer explorer, who spent a few hours upon it in 1832. The Mississippi, a tiny stream ten to fifteen feet in width and one or two in depth, issues from the north end of the lake, and, though its general course to the Gulf is east of south, its direction at first is west of north! By a curious coincidence a tributary of the Red River of the North, rising but fifteen miles west of Itasca, also begins its long race to the sea by taking a direction diametrically opposite to the true one —flowing south instead of north!

The peril mentioned in my first paragraph assailed the forests about the headwaters. The fine stand of white and Norway pines that once covered that part of Minnesota is fast disappearing, and the great lumber companies are on the lookout for every acre that can be made to yield its growth of centuries for their enrichment. For convenience of transportation the lumbermen have followed in the main the natural waterways, floating their logs down-stream to some suitable point for

assembling and shipping by rail. They have worked their way gradually up the Mississippi until in 1901 they were within a dozen miles (direct) of its source, ready at the first opportunity to attack that.

As to the effect of such an invasion one who has made a special study of the subject says: "As soon as the timber shall have been cut . . . the whole tract will become a burned, black and denuded waste, the streams and lakes will dry up and partially disappear and the reservoir dam necessary to drive the logs through and out of Itasca and Elk Lakes into the Mississippi River will drown out every tree and shrub standing upon the shores of said lakes." Another writes: "The reservoir system on the upper Mississippi has already seriously injured and in some cases destroyed the beauty of some of the finest combinations of lake and forest on the continent. It is to be feared that ere long the greed of speculators and the avarice of the lumbermen will finish the work of desecration and desolation." To the truth of these views the bare hillsides along the streams of northern Minnesota and the broad belt of dead, gray timber that encircles the great reservoir of Lake Winnibigoshish—a sort of forest cemetery—bear dumb but eloquent witness.

About 1890 the progress of this work of destruction began to alarm some of the thoughtful men of the state, and through their efforts the legislature in 1891 was induced to pass an act establishing and creating the 'Itasca State Park,' a reservation five by seven miles in extent and including the whole Itasca basin. Much of the land within this area had become private property by homesteading or otherwise, and some was included also in the government grant to the Northern Pacific Railroad. By purchase or condemnation the state soon secured control of the larger part, and since then appropriations have been made from time to time for the completion of such ownership. Some of the land still belongs to private owners and is not yet safe from saw and axe; but the good work is going on, and it is confidently hoped that very soon the last obstacle to the complete success of the plan will disappear.

In the management of the state park it is proposed to follow in general the policy adopted by the national government in regard to the Yellowstone region. Strict laws have been enacted for the protection of trees and game within its limits. Fishing is permitted (rod in hand), but hunting is absolutely prohibited. It is hoped that in time bear, deer and other large animals will come to recognize this reservation, like the Yellowstone Park, as a place of refuge, and that thus some rare species may be saved from extinction. For the enforcement of the laws a commissioner is resident on the grounds, vested with police powers. He is domiciled in a neat and comfortable cottage, built by the state and commonly known as the 'State House.' Our party, by the way, found in the clean beds and excellent fare of

the 'State House' a pleasant relief from the more or less crude comforts of camp life. The charges, too, were extremely reasonable.

With the restriction upon hunting already mentioned, visitors are free and welcome to use the park as their own; and, barring the discomfort of the long, rough ride from Park Rapids, and the size, activity and voracity of the mosquitoes that swarm there in summer, it would not be easy to find a more delightful and satisfying place for an outing. The beauties of woodland, lake and stream, the pure air that blows always in the pine forests, the opportunities for boating, fishing and exploring, and above all its absolute retirement and out-of-the-worldness, commend it alike to sportsman and the mere seeker for change and rest. Of the natural attraction of the valley one has written: "The multitude of clear little gems of lakes, embowered in picturesque hills, Lake Itasca itself a most lovely sheet of water, and especially the grand stretch of virgin forest, mark the park as a chosen corner of Nature's great garden." No less enthusiastic was Schoolcraft, who exclaims: "On reaching the summit our wish was gratified. At a depression of perhaps one hundred feet below, cradled among the hills, the lake spread out its elongated volume, presenting a scene of no common picturesqueness. . . . (It is) one of the most tranquil and pure sheets of water it is possible to conceive." Having had his first view of Itasca from almost the same spot the present writer can testify that the description is not overdrawn. Amid such scenes, with cold springs and grassy, well shaded campgrounds galore, and an abundance of fallen wood for fuel, one is in a veritable campers' paradise.

Utility and sentiment alike endorse the efforts made and making to save this valley from the lumber vandal. While many have lent their aid, the success thus far attained is due in large measure to the efforts of Hon. J. V. Brower, of St. Paul, who has not spared speech nor pen, time nor personal means in his endeavor to arouse the people and their representatives to a sense of what the loss of it would mean. His book on the source of the Mississippi and his large-scale map of the park, showing every detail most accurately, are recognized as authorities on the subject. His study of prehistoric remains on the upper Mississippi is by no means the least interesting part of his work.

The idea certainly is worthy of the great state which is carrying it out and of the sympathy and support of all who take pride in the natural wonders and beauties of our country. New York has made Niagara free; Minnesota is defending the Itasca basin from disfigurement and spoliation.

SOME EIGHTEENTH CENTURY EVOLUTIONISTS. II.

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II. *Diderot.*—Diderot was in even less degree than Maupertuis a contributor to the details of scientific knowledge; and the contrast between the work of the interpreter and that of the investigator of the facts of science is well shown in the relation of his theories to the discoveries of Daubenton. It was the great associate of Buffon who laid the foundations of the science of comparative anatomy, which was to furnish the most important arguments in favor of the theory of evolution; a French writer (Vicq d'Azyr) has even gone so far as to say that 'to the merit of having made a beginning of that science Daubenton has added the merit of having carried it through to completion.' After the publication of the third and fourth volumes of the 'Histoire Naturelle,' an important body of facts and comparisons relating to the anatomy of the vertebrates was accessible to all readers; it is one of the most serious blots upon the reputation of Buffon as a man of science that he failed to appreciate the value of this body of detailed knowledge, and in a subsequent edition of the work cut out Daubenton's anatomical contributions—to the great grief and disappointment of their author. Now the publication of the main facts of comparative anatomy brought clearly to light the striking homologies that run through the structure of all the vertebrate species. Daubenton himself, however, was not the man to see that these homologies suggested, and went far to justify, the hypothesis of the descent of all such species by progressive variation from a common ancestral prototype. His talent was not for the making of hypotheses, but for the collation of facts; he was a cautious and conservative man, capable of infinitely patient and accurate observation, but apparently not capable of penetrating to the significance of the facts which he observed. Even when the evolutionary hypothesis had been put forward by others, he gave it no encouragement; and it was apparently with the purpose of combating it that he contributed a paper to the French Academy of Sciences in 1764, arguing that the anatomical differences between man and the orang-outang are radical, and that man's general structure is elaborately adapted to the maintenance of the erect attitude, as the structure of the ape is not ('Memoires de l'Académie des Sciences,' 1764, p. 568). Similarly he argued, in his introduction to the natural-history volume of the 'Encyclopédie Méthodique' (1783), that man differs so essentially

from the animals, even in his anatomical character, that he ought not to be classed with them; and he expressed surprise that 'it has been possible for a celebrated naturalist to place man in the rank of the quadrupeds, and to associate him in the same class with the monkeys, the lemurs and the bats.'

Minds of another type, however, at once saw how the facts laid bare by Daubenton demanded for their satisfactory explanation a hypothesis such as Maupertuis had already come upon from another line of inquiry. Even Buffon, as is well known, pointed out, in the 'Histoire de l'Âne' in the fourth volume of the 'Histoire Naturelle,' how forcibly the homologies to which his colleague had called attention suggested the idea of a family relationship between all animals. "If," he wrote, "in the immense variety of animate creatures that people the world, we choose as a starting point for our study some one animal, or even the body of man, and if we compare it with all the other organisms, we shall find that . . . there exists a certain primitive and general type (*dessein*) which can be traced out very far. . . . Even in the parts which contribute most to give variety to the external form of animals, there is a prodigious degree of resemblance, which inevitably brings to our minds the idea of an original model upon which every creature seems to have been conceived. . . . As M. Daubenton has remarked, the foot of a horse, in appearance so different from the hand of man, is nevertheless composed of the same bones, and we have at the extremities of our fingers the same small bone of horse-shoe shape which terminates the foot of that animal." By one who considered these facts alone, "not only the ass and the horse, but also man, the ape, the quadrupeds and all the animals might be regarded as constituting but a single family. If it were admitted that the ass were of the family of the horse, and differs from the horse only because it has degenerated, one could equally well say that the ape is of the family of man, that it is a degenerate man, that man and ape have a common origin; that, in fact, all the families among the plants as well as among the animals, come from a single stock; and that all animals are descended from a single animal which in the course of time, as the result of progress or of degeneration, has given rise to all the races of other animals. . . . If it were true that the ass is a degenerated variety of the horse, there would be no longer any limits to the power of Nature, and one would not be wrong in supposing that from a single being she has been able to derive all the other organized beings." But of course Buffon finally pronounced, at least nominally, against such a supposition: *Mais non; il est certain par la révélation que tous les animaux ont également participé à la grace de la création.* Diderot, however—although he was himself not wholly unpractised in perfunctory and ironical professions of orthodoxy—was somewhat more

outspoken; and in his 'Pensées de l'Interprétation de la Nature' he declared plainly that the doctrine of the mutability of species and of their descent from a common prototype was, if not an established truth, at any rate a legitimate and a necessary working hypothesis for all future biological investigation.

The most interesting and most explicit passage on the subject in the 'Pensées' has, so far as I know, been noted by no English writer;* and I therefore translate it without abridgment. "It seems," says Diderot, "that nature has taken pleasure in varying the same mechanism in a thousand different ways. She never abandons any class of her creations before she has multiplied the individuals of it in as many different forms as possible. When one looks out upon the animal kingdom and notes how, among the quadrupeds, all have functions and parts—especially the internal parts—entirely similar to those of another quadruped, would not any one readily believe (*ne croirait-on pas volontiers*) that there was never but one original animal, prototype of all animals, of which Nature has merely lengthened or shortened, transformed, multiplied or obliterated, certain organs? Imagine the fingers of the hand united and the substance of the nails so abundant that, spreading out and swelling, it envelops the whole—and in place of the human hand you have the foot of a horse. When one sees how the successive metamorphoses of the envelope of the prototype—whatever it may have been—proceed by insensible degrees through one kingdom of Nature after another, and people the confines of the two kingdoms (if it is permissible to speak of confines where there is no real division)—and people, I say, the confines of the two kingdoms with beings of an uncertain and ambiguous character, stripped in large part of the forms, qualities and functions of the one and invested with the forms, qualities and functions of the other—who then would not feel himself impelled to the belief that there has been but a single first being, prototype of all beings? But whether this philosophic conjecture be admitted as true with Doctor Baumann [Maupertuis], or rejected as false with M. de Buffon, it can not be denied that we must needs embrace it (*on ne niera pas qu il faille l'embrasser*) as a hypothesis essential to the progress of experimental science, to that of a rational philosophy, to the discovery and to the explanation of the phenomena of organic life" (*op. cit.*, XII.). If the rest of the passage left any uncertainty as to the precise nature of the hypothesis that Diderot had in mind, the reference to Maupertuis and Buffon would make his meaning unmistakable.

* Osborn cites only another and less explicit passage from Diderot; and Mr. John Morley ('Diderot and the Encyclopædists'), although he notes a hint of the idea of natural selection in the 'Lettre sur les Aveugles' (1749), says nothing about the marked evolutionism of the 'Pensées de l'Interprétation de la Nature.'

In a later section of the book, in which he recurs to the subject, the mocking tone of Diderot's professed submission to the 'teachings of the faith,' only makes the more manifest the real opinion that he holds and desires to get accepted. "May it not be that, just as an individual organism in the animal or vegetable kingdom comes into being, grows, reaches maturity, perishes and disappears from view, so whole species may pass through similar stages? If the faith had not taught us that the animals came from the hands of the Creator just such as they are now, and if it were permissible to have the least uncertainty about their beginning and their end, might not the philosopher, left to his own conjectures, suspect that the animal world (*l'animalité*) has from eternity had its separate elements confusedly scattered through the mass of matter; that it finally came about that these elements united —simply because it was possible for them to unite; that the embryo thus formed has passed through an infinite number of successive organizations and developments; that it has acquired in turn movement, sensation, ideas, thought, reflection, conscience, sentiments, passions,—signs, gestures, sounds, articulate speech, language—laws, sciences and arts; that millions of years have elapsed between each of these developments; that there are perhaps still new developments to take place which are as yet unknown to us; that there has been or is to be a stationary condition of things; that the being thus developed is passing out of, or will pass out of, that condition by a continual process of decline, in which his faculties will gradually leave him just as they originally came to him; and that he will finally disappear from nature forever, or rather, will continue to exist, but in a form and with faculties wholly unlike those which characterize him in this moment of time?—But religion spares us many wanderings and much labor." Here, of course, we have not only the transformation of species, but also the sketch of a complete system of materialistic and ateleological evolutional philosophy, after the Spencerian fashion. Most of the chapters of Mr. Spencer's elaborate biography of the universe Diderot gives us in outline:—its 'integration of a diffused, incoherent matter,' its 'successive phases of physical, psychical and social development,' its 'equilibration' and resultant 'stationary state,' and finally its 'alternate cycles of evolution and dissolution.'

The passage first quoted, however, seems to me the more interesting of the two, not only because it is more outspoken and free from the veil of ironical piety, but also because it shows clearly the sources and grounds of Diderot's belief in the mutability of species. He had been stimulated to write largely by the recent appearance of the 'Systéme da la Nature' of Maupertuis; but he ignored the embryological line of argument, and rested his conclusion upon the homologies lately made known by Daubenton and dilated upon by Buffon.

Thus the decade between 1745 and 1755 was marked by the appearance of the attack of Maupertuis upon the ruling doctrine of predelineation; by the publication of the volumes of the 'Histoire Naturelle' which familiarized even the general reader with the unity of type and the homologies of structure that ran through the most diverse species in the writings of the three most celebrated French leaders of scientific opinion of the time; and by the setting forth of two distinct lines of argument in favor of that hypothesis. From this decade, then, dates the appearance of modern evolutionism, as a theory definitely formulated and based upon its proper embryological and anatomical premises.

III. *Herder.*—If certain of the French *philosophes* have received less credit than is their due for their evolutionary opinions, Herder, on the contrary, has often been praised for an early profession of faith in the doctrine of the transformation of species, whereas it is by no means clear that he did not intend explicitly to repudiate it. A German writer, Bärenbach,* has written a book to show that Herder was a precursor of Darwin, and declares that in his 'Ideen zur Geschichte der Menschheit' Herder laid down 'the fundamental laws of the modern development theory, and of the Darwinian theory in particular,' and that he gave clear expression to 'The law of the evolution of organisms, and the theories of the struggle for existence and of natural selection.' Professor Osborn's account of Herder's relation to the theory apparently follows Bärenbach, and as a result is rather misleading. Herder, says Osborn, probably was helped to his evolutionism by 'coming under the influence of Kant's earlier views.' But "Herder was less cautious than his master, and appears almost as a literal prophet of the modern natural philosophy. In a general way he upholds the doctrine of the transformation of the lower and higher forms of life, of a continuous transformation from lower to higher types and of the law of perfectibility." "In his 'Ideen,' published in Tübingen in 1806, . . . we see that Herder clearly formulated the doctrine of unity of type which prevailed among all the evolutionists of the period immediately following."

These few sentences contain a rather undue proportion of errors, and the whole exposition of Herder's position from which they are taken is substantially wrong. It is worth while, therefore, to attempt a more accurate account of Herder's attitude towards evolutionism than is to be found in the current writings on the subject. In a matter of this kind, even accuracy about dates is not wholly to be disdained; and it should be observed that the 'Ideen' were published, not at Tübingen in 1806, but at Riga and Leipzig in 1784–5. Again, Herder, although once a pupil, was no disciple of Kant's; the author of the

* Herder als Vorgänger Darwin's; *cf.* the same writer's monograph on Herder in 'Der neue Plutarch, VI.' My citation is from the latter work; the former is not accessible to me.

'Metakritik' would assuredly have been surprised to hear Kant called his 'master'; and it is sufficiently clear, from Herder's own language, that the influence which led him to employ such expressions as have caused some to consider him an evolutionist, was that of Buffon and other naturalists of the century, not that of Kant. During Herder's student days (1762–4) in Koenigsberg, indeed, it is improbable that Kant's influence could have encouraged a belief in organic, as distinguished from cosmic, evolution. On the other hand, it is not true that Herder was 'less cautious' than Kant in his treatment of the doctrine of transformation; for, by the time of the 'Kritik of Judgment' (1790), Kant had grasped the theory of the descent of species in all its implications and was ready to recognize it as at least a promising hypothesis; while Herder, in the 'Ideen,' argues at length against what he calls 'the improved and totally self-contradictory paradox' that animal species can depart from their divinely-defined character and that man is directly related to the ape.

Yet Herder's book is certainly full of *aperçus* that come near to the evolution theory; and it unquestionably helped to produce a state of mind favorable to the acceptance of the theory. Some passages in the 'Ideen,' read by themselves, might easily seem to justify the classification of Herder with the thorough-going evolutionists. For his position is peculiar and somewhat equivocal. Where he stands in the matter may perhaps best be shown by setting down in catalogue fashion the several contentions that he advanced in regard to the history of the animal kingdom and the relation of the lower species to man.

1. Herder clearly recognized that there had been a sequence of temporally successive forms appearing upon the globe, beginning with simpler forms and proceeding to those most highly organized; 'from stones to crystals, from crystals to metals, from these to plants, from plants to animals and from animals to man, we see the form of organization ascend; and with it the powers and propensities of the creature become more various, until finally they all, so far as possible, unite in the form of man (Bk. V., ch. 1). Each new type as it appears is dependent for its survival upon the prior existence of simpler types—dependent usually, indeed, in a very plain sense, since the newcomer commonly has the earlier-born creatures for its necessary food. "It is manifestly contrary to Nature that she should bring all creatures into existence at the same time. The structure of the earth and the inner constitution of the creatures themselves make this impossible. Elephants and worms, lions and infusoria, do not appear in equal numbers, nor could they be created, in consistency with their natures, at one time or in equal proportions. Millions of shellfish must needs have perished before our bare rock of earth could be made a fruitful soil for a finer type of life; a world of plants is destroyed each year in

order that higher beings may be nourished thereby. Even if one wholly disregards the final causes of the creation, yet even in the very raw material of Nature there lies the necessity that one being should come out of many, that in the revolving cycle of creation countless multitudes should be destroyed so that through this destruction a nobler but less numerous race might come into being" (Bk. X., ch. 2). "Man, therefore, if he was to possess the earth and be lord of the creation, must find his kingdom and his dwelling-place made ready; necessarily therefore, he must have appeared later and in smaller numbers than those over whom he was to rule" (*ibid.*). Most of this Herder might have got from Buffon; and there is obviously nothing in these passages which necessarily implies the mutability of species, nothing which is inconsistent with the doctrine of special but gradual creation. Nor is there even in such a passage as this: "From air and water, from heights and depths, I see the animals coming nearer to man, and step by step approximating his form. The bird flies in the air; every deviation of its structure from that of the quadruped is explicable from its element. The fish swims in the water: its feet and hands are transformed into tail and fins," etc. (Bk. II., ch. 3). If Herder had not elsewhere seemed to deny such a theory, we might at first sight be disposed to construe this passage as an assertion of the literal transformation of species—a Lamarckian sort of transformation, due to the adaptation of organs to needs. But when the words are closely scrutinized it is evident that they require no such interpretation. They say no more than that animals came into being in a progressive order in which the human type was steadily approximated, and in which each form was adapted to its environment.

2. In this connection, Herder liked to dwell upon the homologies of form and structure observable in all vertebrates, and indeed, as he thought, in all creatures, even those that are outwardly most dissimilar. There is a certain *Hauptform* or *Hauptplasma* in which the whole animal kingdom agrees. "It is undeniable that, amid all the differences of the living beings on the earth, a certain uniformity of structure and, as it were, a standard form, appears to prevail, which yet is transformed into the richest diversity. The similarity of the skeletal structure of land animals is obvious; . . . the inner structure makes the thing especially evident, and many outwardly uncouth forms are in the essentials of their internal anatomy exceedingly like man. The amphibia deviate farther from this standard; birds, fishes, insects, aquatic animals—the last of which merge in the vegetal or inorganic world—deviate still farther. Beyond this our eyes can not penetrate; but these transitions render it not improbable that in marine forms, plants, and even in the so-called inanimate things the same basis of organization may rule, though infinitely more rude and confused. In

the eye of the Eternal Being, who sees all things in one connected whole, it may be that the form of the ice-particle, as it is generated, and that of the snowflake that is formed upon it, may have an analogous resemblance to the formation of the embryo in the womb. We can therefore accept it as a general law that, the nearer they approach man, the more do all creatures resemble him in their essential form; and that Nature, amid the infinite variety which she loves, seems to have fashioned all the living things upon our earth after a single original model (*Hauptplasma*) of organization" (Bk. II., ch. 4).* Herder had also learned from the comparative anatomists that it is a corollary to this similarity of structure that organs which function usefully in certain species appear also in other species where they have little or no apparent use or function; in other words, he knew of the existence of vestigial and rudimentary organs. "What Nature had given to one animal as a merely accessory feature (*Nebenwerk*) she has developed into an essential feature in another; she brings it into plain view, enlarges it, and makes the other organs—though still in perfect harmony—subservient to it. Elsewhere again these subordinate parts predominate; and all organized beings appear as so many *disjecti membra poetæ*. He who would study them must study one in another; where an organ appears neglected or concealed, let him turn to some other creature in which Nature has perfected and plainly displayed it" (*loc. cit.*).

3. Herder had further learned from Buffon that, within the limits of the specific type, a species may vary widely under differing climatic influences. 'Those species that inhabit nearly all parts of the globe, are differently formed in almost every climate,' etc. (Bk. II., ch. 3).

4. The author of the 'Ideen' also recognized, and frequently dilated upon, that fact in nature which later suggested the specifically Darwinian form of the theory of descent—the fact, namely, that nature turns out more aspirants for life than she can provide with the means of living, and that there results from this situation a universal struggle for existence between species and between individuals. Herder had, in fact, been profoundly impressed by the way in which the life-processes of nature seem to be the expression merely of a blind, striving *Wille zum Leben* (in the language of a later school), careless of the single life, tending only to the production of the greatest possible number of living beings, each of them competing with all the others. The discovery of this impressive and sinister aspect of nature was, certainly, the main source, alike of the most important scientific hypothesis

* This passage is given in part in 'From the Greeks to Darwin'—being the only citation from Herder there given; but the translation is singularly inaccurate, and in one place makes Herder appear to say the opposite of his real meaning.

of the nineteenth century, and of certain of the most significant and characteristic developments of nineteenth century philosophy—especially of philosophical pessimism. The emphasis which Herder lays upon this class of facts is therefore interesting and noteworthy: "Where and when each being *could* arise, there it arose; energies (*Kräfte*) pressed in through every gate of entrance and formed themselves to life" (Bk. X., ch. 2). "Nature employs infinitely many germs; . . . she must needs therefore reckon upon some loss, since all things crowd one another (*alles zusammengedrangt ist*), and nothing finds room completely to develop itself" (Bk. II., ch. 2). "The whole creation is at war, and the most conflicting powers lie close to one another. . . . Each being strives with each, since each itself is hard-pressed for life; it must save its own skin, and guard its own existence. Why does nature act thus? Why does she thus crowd her creatures one upon another? Because she aimed to produce the greatest number and the greatest variety of living things in the least possible space; so that one subdues another, and only through the equilibrium of opposing powers is peace brought about in the creation. Every species cares for itself as if it were the only one in existence; but by its side stands another which keeps it within bounds; and it was only in this adjustment of warring species that creative nature found the means of preserving the whole" (Bk. II., ch. 3). In all this Nature (for Herder almost invariably personifies) takes no account of the individual, but rather sacrifices him ruthlessly to her 'one great end, which is—not the little end of the sentient creature alone, but—the propagation and continuance of the species.' And in this connection Herder anticipates Schopenhauer in picturing the pleasures of the love of the sexes, and the romantic illusions connected with that love in man, as merely a subtle trick whereby nature cajoles the individual to sacrifice himself to her larger aim. Schopenhauer's famous chapter on the 'Metaphysics of the Love of the Sexes' is little more than an amplification of a passage in the second book of the 'Ideen.' Always, Herder perceives, when the reproduction and increase of life is at stake, nature turns Machiavelian, and plays upon the egoism of the individual for her own very different ends. "It is," he writes, "particularly humiliating to man that in the sweet impulses which he terms love, and to which he attributes so much spontaneity, he obeys the laws of nature almost as blindly as a plant. . . . Two creatures sigh for each other, and know not for what they sigh; they languish to become one, which dividing nature has denied; they swim on a sea of deception. Sweetly deceived creatures, enjoy your time; yet know that ye accomplish not your own little dreams, but, pleasantly compelled, the great aim of nature. . . . As soon as she has secured the species, she suffers the individual gradually to decay. Hardly is the season of love over

before the stag loses his proud antlers, the bird its song and much of its beauty, the plants their fairest colors. The butterfly sheds its wings and expires, while alone and unweakened it might have lived through half the year. This is the course of nature in the development of beings out of one another; the stream flows on, though one wave is lost in the wave that succeeds it" (Bk. II., ch. 2).

But although Herder thus clearly remarked these characteristics of nature's dealings, he did not deduce from them either the biological or the philosophical consequences which have since become so familiar. It did not occur to him to find in the facts of the over-production of organisms and the struggle for existence an explanation—such as Maupertuis had already proposed—of that progressive production and selection of more highly organized and better adapted beings, the reality of which he so fully recognized. Nor was he led, by his apprehension of a universal tendency to the maximum production of living things, to erect the notion of 'unconscious will' into the central conception of a metaphysical system.

5. In his accounts of the beginnings of human society, and of the moral instincts without which society could not exist, Herder points out that these beginnings were made possible and necessary by a prior peculiarity in the physiological constitution which distinguishes the human species—namely, by the greater length of the period of helpless infancy. This, of course, is an idea upon which many evolutionary moralists and 'sociologists' have latterly delighted to dwell. Herder clearly sets forth how the prolongation of infancy was the condition and the chief cause of man's moral nature—how it provided the true training school in which the featherless biped was fitted for the social state: "The first society arose in the paternal habitation, bound together, by the ties of blood, of mutual reliance, and of love. Thus to destroy the savagery of men and to habituate them to domestic intercourse, it was necessary that the infancy in our species should continue for some years. Nature held them together by tender bonds, so that they might not separate and forget one another, like the beasts that soon reach maturity. The father becomes the teacher of his son, as the mother has been his nurse, and thus a new tie of humanity is formed. Herein lay the ground of the necessity of human society, without which it would have been impossible for a human being to grow up, and for the species to multiply. Man is thus born for society; this the affection of his parents tells him, this the years of his longer infancy show" (Bk. IV., ch. 6).

This conception, however, was by no means a new idea of Herder's own. It is, therefore a little curious to find the idea put forward by evolutionary writers of the end of the nineteenth century as a fresh and striking discovery. Even so learned a man as the late Mr. John

Fiske supposed it to be a great novelty, and even conceived that he himself was the original discoverer of it. In the preface to his 'Destiny of Man' Mr. Fiske writes: "The detection of the part played by the lengthening of infancy in the genesis of the human race is my own especial contribution to the doctrine of evolution, so that I feel somewhat uncertain as to how far that subject will be understood." But the thing had been detected, not merely by Herder, but also by Pope, some fifty years before him; and that Mr. Fiske should have forgotten the fact only shows how general are the misapprehensions which concern the history of biological conceptions. Pope wrote, in the Third Epistle of the 'Essay on Man' (1733):

> Thus beast and bird their common charge attend,
> The mothers nurse it, and the sires defend;
> The young dismissed, to wander earth or air,
> There stops the Instinct, and there ends the care.
> A longer care man's helpless kind demands,
> That longer care contracts more lasting bands . . .
> Still as one brood, and as another rose,
> These nat'ral love maintained, habitual those:
> The last, scarce ripened into perfect man,
> Saw helpless him from whom their life began;
> While pleasure, gratitude and hope combined
> Still spread the interest, and preserved the kind.

Pope got the suggestion of this from one of Bolingbroke's 'Fragments'; but Bolingbroke had missed the main point, which Pope, in this case more original than his guide, clearly perceived. "If men," Bolingbroke had written, "come helpless into the world like other animals; if they require even longer than other animals to be nursed and educated by the tender instinct of their parents; it is because they have more to learn and more to do; it is because they are prepared for a more improved state and for greater happiness."

Bolingbroke failed to see that the most important consequence of the greater length of human infancy lay in its effect, not upon the child, but upon the parent—in creating the necessity for a steady and self-sacrificing affection and for a habitual subordination of immediate and personal aims to remote and disinterested ones. It may be, then, that to Pope should be given the credit of having first called attention to the relation between the lengthening of infancy and the evolution of social morality. It can hardly be doubted that it was the passage in Pope's poem that suggested the idea to Herder.

6. In all these cases the receptive and pregnant mind of Herder had grasped and elaborated separate ideas which have since become familiar parts of the general body of evolutionary theory. But did he accept the essential doctrine of evolution itself? Did he believe in the mutability of species and in the literal descent of man from lower

forms of life? If I am able to interpret his utterances correctly, he did not; on the contrary, he seems to have been at pains to express his dissent from such a doctrine,—which, as we have seen, was familiar enough to the men of science of his time. There are several distinct passages in the 'Ideen' in which Herder discusses the relation of man to the animal kingdom; and, in order that the reader may have the means of deciding for himself what Herder's position was, I will cite them at some length. "There are those," he says (Bk. III., ch. 6), "who have, I will not say degraded man to the rank of a beast, but have denied to him the character of his race, and would make him out to be a degenerate animal (*ausgeartete Thier*) which in striving after a higher perfection has wholly lost the distinctive qualities (*Eigenheit*) of its species. This, however, is manifestly contrary to the truth and to the evidence of natural history; man obviously has characteristics that no animal possesses, and performs actions of which both the good and the evil belong to him alone. . . . Since every animal remains true upon the whole to the character of its species, and since we alone have free will instead of necessity for our ruling power, then this difference must be investigated as a fact—for fact it undeniably is. The other questions—how man came by this distinctive characteristic; whether it was his from the beginning, or is adventitious and acquired: these are questions of a purely historical sort. Now, setting aside all metaphysics, let us confine ourselves to physiology and experience." Herder then points out the anatomical peculiarities of man, particularly those which, as Daubenton had shown, are connected with his greatest peculiarity, the upright attitude. And in view of these considerations Herder concludes thus: "Would the human animal, if he had been for ages in an inferior state—and if he had been formed as a quadruped in his mother's womb, with wholly different proportions—would he have left that state of his own accord and have raised himself to an erect posture? Out of the faculties of a beast, which would ever be drawing him backward, could he have made himself a man, and, even before he became a man, have discovered human speech? If man had ever been a four-footed animal, if he had been such for thousands of years, assuredly he would remain such still; and nothing but a miracle of new creation could have made him what he now is. Why, then, should we embrace unproved, nay totally self-contradictory, paradoxes, when the structure of man, the history of his species and, as it seems to me, the whole analogy of the organization of our earth, lead us to another conclusion? No creature that we know has ever departed from its original organization and adapted itself to another contrary to it; for it can operate only through the powers that inhere in its organization, and Nature is abundantly able to hold each living being fast in that state to which she has assigned it. In man everything is adapted to the form he now

bears; from this everything in his history is explicable; without it nothing is capable of explanation. . . . Why should we humble in the dust the crown of our high calling, and shut our eyes to that central point in which all the radii of Nature's circle seem to converge?"

In a later passage (Bk. VII., ch. 1) Herder directly discusses, only to reject, the theories of those (he probably has Monboddo especially in mind) who assert a kinship, or an identity of species, between the apes and man. "I could wish," he writes, "that the affinity of man to the ape had never been urged so far as to cause people to overlook, in seeking a graded scale (*Leiter*) of being, the actual steps and intervals without which no scale can exist. What, for example, can the rickety orang-outang explain in the figure of the Kamchatkan, the pigmy chimpanzee in the size of the Greenlander, the pongo in the Patagonian? for all these forms would have arisen from the nature of man if there had been no such thing as an ape upon the earth. . . . In point of fact, the apes and man were never one and the same species (*Gattung*). For each race nature has done enough, to each she has given its own proper heritage. The apes she has divided into as many species and varieties as possible, and extended these as far as she could. But thou, O man, reverence thyself! Neither the pongo nor the gibbon is thy brother; the American and the Negro are. These then thou shouldst not oppress nor kill nor rob, for they are men like thee; but with the ape thou canst not enter into fraternity." Herder expresses himself in a similar vein in a preface which he wrote for a German translation (1784) of the work in which Lord Monboddo set forth, among other things, his theory of the close relationship of man and monkey. Herder praises cordially Monboddo's taste for ancient art, and his large and philosophical way of dealing with the problem of the origin and development of human language; but he warns the reader against Monboddo's views on the orang-outang. The opinion that '*Affe und Mensch ein Geschlect sei,*' Herder marks as 'an error which even the facts of anatomy contradict.'

In another chapter of the 'Ideen' Herder speaks of the transitions (*Uebergange und Ueberleitungen*) and metamorphoses (*Verwandlungen*) through which nature leads the successive orders of animals, in a fashion which seems at first sight plainly to imply the derivation of higher from lower species by ordinary descent; yet in the same paragraph he pauses to insist upon the fixity of specific types: "It may appear that such transitions are incompatible with the definiteness of form to which every species remains true, and in which not the smallest bone undergoes alteration. But the reason for this invariability is apparent; since every creature can receive its organization only from other creatures of its own species. Our orderly Mother Nature has thus plainly predetermined the way by which any organic power

should come into existence (*Wirksamkeit*); and thus nothing can escape from its once-determined form" (Bk. V., ch. 3).

It is hard to see how any reader of Herder's generation could have understood these utterances, when taken all together, in any other sense than as an assertion of the essential immutability of species and a denial of man's descent from simian or any other animal ancestors. It would appear then, that Herder never fully recognized that—as Kant put it—'the similarity of form in animals (such that they seem to be make after a common prototype) confirms the supposition that they have an actual blood-relationship, through descent from a common parent.' How, in the absence of such an hypothesis, Herder would have explained the gradual appearance of progressively higher forms is, undeniably, somewhat incomprehensible. But the truth is that his whole treatment of the subject is poetical, vague and not very careful of consistency, rather than explicit, definite and scientific. The theory of descent was, at the time he wrote, almost a commonplace of current biological discussion; but his attitude towards it was certainly ambiguous, and apparently hostile. The author of the 'Ideen zur Geschichte der Menschheit' may almost be called the father of the modern philosophy of history; but he can not unqualifiedly be called a pioneer of modern evolutionist biology.

IV. *Monboddo.*—The author of the work that called forth Herder's mingled admiration and criticism, James Burnett, Lord Monboddo, has been a good deal neglected by the historians of evolutionism; and, in spite of the fact that he was perhaps the first to make widely familiar to the British public the doctrine that man is descended from ape-like ancestors, it is doubtless true that his can not be considered a very serious contribution to the progress of zoological knowledge. This learned, original and whimsical judge is a highly picturesque and interesting figure in the literary history of Scotland in the eighteenth century. He was one of the conspicuous leaders of the intellectual society of Edinburgh at a time when the Scotch Athens—even while Jacobite uprisings still threatened—was one of the most notable seats of scientific and philosophical inquiry in Europe. In the circle of Monboddo's intimates were such men as David Hume; Adam Smith; Hutton, the founder of modern geology; Black, originator of pneumatic chemistry and of the theory of latent heat; Robertson, the historian; Lord Kames; Dugald Stewart, and, among the men of letters, Home—a dramatist whom Monboddo preferred to Shakespeare—and Fergusson. Lord Monboddo played the host to Burns in Edinburgh, and to Johnson at his ancestral country-seat—the conversation of the two great men on this latter occasion being recorded with great gusto by Boswell, who dearly loved to see the sparks fly at the contact of opposing

minds. In order to promote intellectual conviviality among his learned fellow townsmen, Monboddo introduced the innovation of late dinners —for his literary suppers, we are told by one who attended them, 'had all the variety and abundance of a principal meal,' and were modeled after the symposia of the ancients. In this society, so distinguished for scientific attainments and for original theories in natural science and philosophy, Monboddo had the reputation of being one of the most learned and most original. His speculations about the origin of language were only less notable, as a piece of pioneering in a new science, than was the work of Smith, of Hutton and of Black; and he had the insight to suggest—though only in a private letter—the theory of the common descent of the European tongues and Sanscrit, a language then newly made known to the Occident by his correspondent, Sir William Jones. But it was felt by most of Monboddo's British contemporaries that he pushed originality in theorizing to the point of fantastic absurdity when he declared that civilized man is akin to the orang-outang and a descendant of progenitors that lacked speech and possibly had tails. The Judge's chapters on the orang-outang sent learned Britain into inextinguishable laughter, and many were the poor witticisms made at his expense. The most vigorous and most amusing of all his critics was the great representative of a common-sense conservatism, Dr. Johnson. Gibes and invectives directed against the author of so ludicrous and so scandalous a doctrine are constantly recurring in the pages of Boswell: "Sir, it is as possible that the orang-outang does not speak, as that he speaks. However, I shall not contest the point; I should have thought it impossible to find a Monboddo; yet he exists." "It is a pity," said Johnson again, "to see Lord Monboddo publish such notions as he has done; a man of sense and of so much elegant learning. There would be nothing in a fool doing it; we should only laugh; but when a wise man does it, we are sorry. Other people have strange notions, but they conceal them; if they have tails, they hide them; but Monboddo is as jealous of his tail as a squirrel." But Johnson's final objection is expressed in these words: "Sir, it is all conjecture about a thing useless even if it were known to be true. . . . Conjecture as to things useful is good; but conjecture as to what it would be useless to know, such as whether man went on all four, is very idle." The intellectual history of the century that followed constitutes an ironical commentary on this dictum of the great eighteenth century conservative.

Monboddo's opinions concerning the descent of man are expressed most at length in the first volume of the 'Origin and Progress of Language,' published in 1773; some further hints of them may be found here and there in the letters of Monboddo recently collected and

edited by Professor Knight.* Those opinions are entirely incidental to his theory of language. Monboddo nowhere discusses the general biological question of the transformation of species, and possibly did not believe in the transformist doctrine as such—so that it is perhaps too much to call him, with Professor Knight, 'a virtual evolutionist, holding an honoured place between Lucretius and Darwin.' The main contention of his book concerns the evolution of man's language, not of man himself, and is to the effect that language can have arisen only after man had for some time lived in the political state, 'which state is not natural to man any more than the language to which it gave birth.' In order to establish such a theory it is desirable, if not essential, to point to instances of societies of men living without language; and it is at this juncture that Monboddo meets the difficulty by bringing forward his doctrine about the orang-outang.

That doctrine is that man and the orang-outang are one and the same species. What the orang-outang is our ancestors were. The orang-outang and chimpanzee are varieties of men that have failed to acquire the art of speech; or—what comes to the same thing, for Monboddo—our ancestors were a community of orang-outangs who succeeded in acquiring that art. It is evident that in such a contention a belief in transformation is not necessarily implied; in fact, in order to establish our descent from the orang, Monboddo seems to think it necessary to establish strict identity of species—thus implying that species can not descend from other species. In the 'Origin and Progress' he explicitly declines to generalize his doctrine. "Though I hold the orang-outang to be of our species, it must not be supposed that I think the monkey or ape, with or without a tail, participates of our nature; on the contrary, I maintain that however much his form may resemble ours, he is, as Linnæus says of the Troglodyte, *nec nostri generis nec sanguinis.*" In one of the letters in Professor Knight's volume, however, Monboddo writes: "I think the simian race is of kin to us, though not so nearly related (as the orang-outang). For the large monkeys and baboons appear to me to stand in the same relation to us that the ass does to the horse, or our gold-finch to the canary-bird." What he conceived that relation to be, he does not tell us; but it may fairly be supposed that he was thinking of collateral descent from a common ancestral species.

Monboddo's statements of his position, and his arguments for it, are made somewhat ambiguous by the fact that he, like Herder, is not altogether clear as to what constitutes identity of species, though he notes Buffon's definition, which makes the only test of difference of

* 'Lord Monboddo and his Contemporaries,' London and New York, 1900. My citations from Monboddo are taken from the second edition of the 'Origin and Progress,' Edinburgh, 1774.

species in animals to be the infertility of their offspring. Monboddo thinks we can find other criteria that are as conclusive and easier to apply. We are entitled, he holds, to assign to the same species all animals which possess in common a large—but an undefined—number of similar characteristics, provided that these characteristics appear to be essential and 'such as have great influence upon their nature.' Now the orang-outang greatly resembles man in his external form, his anatomical structure, and even in his 'inward principle,' the 'natural habits and dispositions of the mind.' Upon this last point of resemblance Monboddo particularly likes to dilate; it seems to be his principal criterion of unity of species. The reason why the baboons and other monkeys are, in the published treatise, denied kinship with us is because, similar to us in other respects, they lack this intellectual resemblance. Of the intellectual parts and the charm of temperament of our brother the orang, Lord Monboddo exhibits an extremely exalted opinion: "The orang-outang has the human intelligence, as much as can be expected in an animal living without civility or arts: he has a disposition of mind mild, docile and humane: he has the sentiments and affections peculiar to our species, such as the sense of modesty, of honor and of justice; and likewise an attachment and friendship to one individual so strong in some instances that one friend will not survive the other: they live in society and have some arts of life; for they build huts and use an artificial weapon for attack and defence, viz., a stick; which no animal merely brute is known to do. They show also counsel and design, by carrying off creatures of our species for certain purposes, and keeping them for years together without doing them any harm; which no brute creature was ever known to do. They appear likewise to have some kind of civility among them, and to practice certain rites, such as that of burying the dead." The female orang-outang, it appears upon the testimony of Bontius the Batavian physician, is modest to the point of prudery; and some of the species are of so fine a sensibility that they shed tears copiously upon being parted from persons to whom they have become attached.

Monboddo's arguments for his theory come somewhat nearer to the proper homological proofs of evolution when he points out that the *os coccygis* is plainly nothing but a rudimentary and abbreviated tail, and that the civilized man thus carries about upon him a tell-tale member which hopelessly betrays the secret of his ancestry. Monboddo seems to opine that the loss of the tail by mankind has been comparatively recent, and that it is by no means universal; in justification of this opinion he adduces a number of travelers' stories that are more diverting than plausible. There is, for example, the story told by a Swedish sailor—whose credibility was vouched for by Linnæus—who saw on one of the Nicobar Islands 'a race of men that trafficked and

used the art of navigation, who had tails like those of cats, and which they moved in the same manner.' This narration is perhaps exaggerated, Monboddo admits; but 'that there are men with tails is a fact so well attested that it can not be doubted.' For, setting aside all travelers' reports, and the testimony given by the ancients to the existence of races of *homines caudati*, he himself had known of a Scotch schoolmaster in Inverness who had a tail half a foot long. The man prudently kept his unusual endowment concealed during his lifetime, but it was discovered after his death:—of all of which Lord Monboddo offers to bring legal evidence. The superficial and the dogmatists, he adds, will no doubt think these stories very ridiculous, 'but the philosopher, who is more disposed to inquire than to laugh and deride, will not reject it at once as a thing incredible that there should be such a variety in our species, as well as in the simian tribe which is so near akin to us.'

All these arguments *a posteriori* are really irrelevant to Monboddo's main thesis about the relation of man to the orang-outang; since those particular 'simian tribes' with which alone he declares man to be akin (*i. e., satyrus* and *troglodytes niger*) are destitute of tails, and have an even more rudimentary coccyx than man. The fact that men had tails would, from his own standpoint, rather tend to show that man and orang belonged to different species, than that they belonged to the same. Of this Monboddo seems to be not unaware, for he introduces his stories of tailed men as a sort of digression, and not as a part of his principal argument. As it stands, his discussion about tails seems rather to resemble the caudal vertebræ with which it is concerned—it suggests a good deal, but is not designed to bear any of the weight of proof, and is a relatively functionless appendage to the main body of his theory.

The comparative crudity and superficiality of Monboddo's speculations about the descent of man are one indication of the fact that, down to the end of the eighteenth century, the country of Darwin had made far less progress in this part of biology than had France and Germany. For Monboddo's book seems to be the nearest approach to an assertion of the mutability of species and the derivation of man from animal ancestors which was made by any generally read English writer, until the 'Zoönomia' of Dr. Erasmus Darwin appeared in 1794.

ITALIAN AND OTHER LATIN IMMIGRANTS.

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ITALIAN immigration was insignificant until 1880. In that year we received about 12,000 Italian immigrants, and since that time the number increased steadily until the year 1891, when 76,000 arrived in the United States. This number was not exceeded until 1899, when the total yearly Italian arrivals began again to increase and in the past year (1903) reached the astounding total of 233,546. Eighty-five per cent. of this total was made up of southern Italians. The following tables indicate the distribution of Italians landed in the United States in 1903:

NORTH ITALIANS.

State.	Number of North Italians.	Ratio to Total North Italians Landed.
New York	9,452	25 per cent.
Pennsylvania	7,461	20 "
California	5,369	14 "
Illinois	3,163	8 "
Massachusetts	2,233	6 "
Connecticut	1,242	3.5 "
Michigan	1,209	3.5 "
New Jersey	1,158	3 "
All other states	6,142	17 "
Total	37,429	100 per cent.

SOUTH ITALIANS.

State.	Number of South Italians.	Ratio to Total South Italians Landed.
New York	91,774	47 per cent.
Pennsylvania	42,696	22 "
Massachusetts	13,731	7 "
New Jersey	9,970	5 "
Illinois	6,637	3 "
Connecticut	6,301	3 "
Ohio	5,372	3 "
Louisiana	4,815	2 "
Rhode Island	3,515	2 "
West Virginia	2,096	1 "
All other states	9,210	5 "
Total	196,117	100 per cent.

In considering Italian immigrants it is necessary to recognize the differences existing between northern and southern Italians. The northern Italian is taller, often of lighter complexion, and is usually in a more prosperous condition than his brother from the south. The northern Italian is intelligent, can nearly always read and write, and very often is skilled in some trade or occupation. He compares favorably with the Scandinavian or German, and his desirability as an im-

migrant is seldom questioned. He usually leaves Italy through the representations of friends in this country, and therefore comes here with a definite purpose, and is not at the mercy of a 'padrone.' On the other hand, the southern Italian, short of stature, very dark in complexion, usually lands here almost destitute. His intelligence is not higher than one could imagine in the descendant of peasantry illiterate for centuries. He can seldom read and write, and invariably is an unskilled farm laborer. He has little money and often has no definite purpose, and naturally must depend on some one who speaks his language. In this way he falls into the hands of the 'padrone.'

The early Italian immigrants were of the itinerant class—rag-pickers, organ-grinders, etc., but after 1870 these were succeeded by the Italian peasantry of the south, who were forced by economic conditions and poverty at home, to emigrate. They came here at first to supply the demand for unskilled laborers, occasioned by the great industrial activity following the civil war. In a majority of instances these immigrants were brought here and taken charge of by padroni and Italian bankers and were sent by the padroni in every direction where their labor was needed. The Italian peasant is peculiarly susceptible, by reason of his ignorance, to any system of blackmail or extortion. In Italy, for years the Camorristi terrorized and imposed tribute upon the ignorant peasantry, and it was natural that, following this experience, they should continue to be victims to the same practises in another form. Italians of superior educational and intellectual attainments in America have been as unscrupulous and vulture-like in the treatment of their ignorant brethren, as were the Camoristi in the zenith of their power. The extortioners in America have been known as padroni and bankers. Just when the padroni first appeared in America is open to question. He was much in evidence toward the close of the civil war, when the demand for laborers was out of all proportion to the supply. At this time contractors and manufacturers could contract in Europe for large numbers of laborers without violation of law, by reason of legislation enacted in 1864. This privilege gave the padroni their opportunity. Previous to that time their importations were almost all peddlers, organ-grinders, harpers and other itinerant musicians.

In the beginning the American employer of labor, in his anxiety to secure a large amount of cheap labor for some particular enterprise, would apply to an Italian immigration agent for a certain number of men. The agent, or padrone, in turn would secure the men through sub-agents in Italy and have them shipped across on prepaid tickets, for which he charged a liberal commission. Upon their arrival, the agent, or padrone, boarded them at immense profit, pending their distribution here, and received his compensation from the American contractor, who took it out of their prospective wages. The contract of

supplying the workmen with food and shelter while working was often in the hands of the same man. Sometimes the padrone was also banker, and, if so, he charged exorbitant rates for sending the laborer's meager savings to Italy. He also counted on the chance, which came to him in a majority of cases, of making a profit on their return tickets to Italy.

Later these agents, or padroni, became independent of the American contractors. Instead of procuring men for the contractor and depending on him for their remuneration, they became wholesale importers on their own account and induced large numbers to emigrate from Italy, by promises which seemed to open fairyland to the Italian 'cafone.' They always insisted on a contract for one to seven years. The men were farmed out to whoever would pay the padrone for their labor, usually as laborers with pick and shovel. The padrone boarded his people, charged them for all necessary things at exorbitant rates, and at the end of the year the laborer had very little coming to him. Nor was the system of slavery confined to men. Women were included and frequently placed in houses of prostitution. Little children were brought here in the same way and forced to black boots or sell newspapers, flowers or fruits, for the benefit of the padrone.

The traffic in helpless humanity, as carried on by padroni twenty-five years ago, has been gradually checked. The importation of women and minor children was first stopped by governmental action, aided by philanthropic societies. The wholesale importation of labor was not stopped, however, until after the passage of the first contract labor law in 1885. The enforcement of this law, aided by the hearty cooperation of the Italian government, finally ended the degrading practise. The padrone system, as it once existed, is now a matter of history. The skeleton of the padrone exists, but he is now nothing more than an employment agent, a high-priced and unlicensed employment agent, it is true, but with less of the absolute power over the peasant, which in the past made their relations those of master and slave.*

Probably the so-called Italian banks are as potent a means of extortion as the padrone system itself. The padrone is sometimes a banker, and, if not, is always in league with one. Between them they take advantage of the child-like credulity and ignorance of the Italian laborer, and fleece him of his last dollar.

The southern Italian concerns us most in considering the desirability of the Italian immigrant. His northern brother need give us no more concern than the representatives of the United Kingdom, Germany or Sweden. The most striking feature presented by Italian

* The padrone system as it exists to-day is graphically described by John Koren, Esq., in a bulletin published by the Department of Labor.

immigration is the comparatively small number who engage in farming, despite the fact that 85 per cent. of this immigration is made up of the peasant class. This phenomenon can be explained by the fact that the immigrant is both poor and ignorant. His poverty forces him to accept whatever work is offered. His ignorance and inability to speak our language prevent him from learning the possibilities of American agriculture. He looks with distrust on an agricultural occupation, as likely to be unremunerative and enslaving, as he found it at home. Then the rural life at home was very different from rural life here. In Italy the peasants for the most part live in big villages or towns, and go to their work early in the morning, returning to their home in the evening, so that when the day's work is done they can rejoin their family among thousands of their own kind.

The crowding of Italians into our large cities can be understood if one studies the padrone system and padrone banks. The poor, ignorant laborer is at the mercy of the padrone and banker, and if he could leave, does not know where to go. He has no friends to show him the way, to inform him of the homestead law or of the wages paid farm laborers. But he finds friends (?) speaking his own language in the great city who will get him a 'job,' and so he stays in the city. He is sent out on contract labor and probably in the fall, when the work is done, arrives in the city again with very little money to face the winter. Often he finds it cheaper to pay the steerage rate and go back to sunny Italy than to stay in cold New York, where fuel is a necessity and provisions dear.

The Italian as an agricultural immigrant is a success, and the regrettable feature of Italian immigration is the small percentage who go to rural communities. Italian agricultural colonies in and around Vineland, N. J., are prosperous and growing. The Italians in Texas have been uniformly successful in rice and cotton culture, truck farming and vine growing. They have been very valuable in Louisiana, Mississippi and other southern states, as a substitute for the unreliable, shiftless negro. Their success in California, where they found the climate particularly suited to them and their favorite occupation, vine and fruit growing, has been one of the features of the development of California. The report of the Italian Chamber of Commerce, San Francisco, 1897, gave 47,625 Italians living in the 56 counties of California, almost all engaged in agriculture, owning 2,726 farms. Eight hundred and thirty-seven business concerns had a capital of $17,908,-300, the total capital for Italian business men, ranchers and farmers aggregating, according to this report, $114,325,000.

Italians have been established near many of our largest cities upon truck farms, and in almost every instance are successful. The Italian colonies in Alabama are thriving and prosperous communities, with schools and churches.

The average stature of Italians is very much below the medium, but, nevertheless, they are wiry and muscular and capable of prolonged physical exertion. The country-bred Italian bears the insanitary conditions of the tenement houses very badly. He succumbs to disease as a result of tenement house conditions more readily than the Hebrew, who for generations has been a dweller in the crowded insanitary districts of large towns and cities, and has acquired a certain degree of resisting power against diseases due to overcrowding, filth and lack of pure air and sunlight. Italian children reared in the Italian quarter of New York, Boston, Philadelphia or Chicago are prone to tubercular disease and rickets, and compare unfavorably with children brought up in Sicily or Italy. Consumption is frequent among tenement-house Italians, although extremely rare in recently arrived immigrants.

Mentally the Italian immigrant is what might be expected of peasantry whose average illiteracy is 48 per cent. However, the possibilities of the Italian peasant, properly educated, are very promising. They are very quick to learn, have a deftness of hand which adapts them to trades requiring manual skill, and their artistic sense is always developed, though it sometimes does violence to the esthetic color sense of hyper-critical Americans.

The moral standard of the Italian family is very high, and Italian women are deservedly noted for the homely virtues, which make womanhood, of whatever nationality, revered.

The crimes charged to the Italians are usually crimes of violence, actuated by revenge for real or fancied wrongs. These are outgrowths of the custom of taking the law in their own hands in a country where the poor had little or no redress from the law. But in the aggregate of crime the Italian, by reason of his sobriety, presents a better record in this country than many of the races commonly classed as desirable. The Italian seldom becomes a public charge, because of his willingness to work at any kind of labor that offers. He does not become pauperized. He applies for and receives charity less often than many of our other city-dwelling immigrants. He is frugal and, in spite of the robbery to which he is subjected by padrone or banker, manages to save some of his earnings. If he has no other prospect, when winter, lack of work and poverty stare him in the face, he usually has the price of steerage passage to Italy, and migrates to reappear at some more opportune season. This migratory tendency of the Italian laborer has caused a great deal of comment upon his value to the country. There is little doubt that the Italian goes back and forth between Europe and America more than any other people. They have earned the title of 'birds of passage' by their habit of flitting back and forth and have been accused of sending vast sums of money home and, in many instances, of going home to live in luxury on the money they earned in America.

Instances are recorded where Italians have arrived in America as immigrants, who admitted having been here six or seven times before. It is certain, however, that the Italian laborer, in a majority of instances, gradually gets accustomed to American ways and finds things at home more strange on each succeeding visit, and eventually loses all desire to live permanently in his native land. He goes back and forth to see his old parents, to escape destitution in a New York tenement when out of work, or to arrange, if he is prosperous enough, to bring his family here.

Nothing illustrates the growing permanency of our Italian immigrants with greater force than the ever increasing proportion of women and children now recorded among Italian immigrants. Whenever the Italian is able to shift for himself, when he is independent of the padrone and Italian banker, he is likely to be a permanent and useful citizen. The sums alleged to have been sent to Italy by Italian laborers here have been grossly exaggerated, and it is doubtful if any Italian, successful enough here to acquire a competence, could escape Americanization, or have any desire to live in Italy after having adopted American ideas of living. The Italian laborer sends money to Italy to his aged parents or to his wife, to help pay rent, taxes and other burdens at home. He does this from a high sense of filial or marital duty, for the Italian never forgets his duty to either parent or wife, and surely this devotion is commendable; but his desire in many instances is really to establish a home and bring his dependent ones here to live with him.

The Italian is gradually becoming independent of the padrone. He is also beginning to learn the splendid possibilities for independent effort in agricultural pursuits. That there is a great field for him is shown by his success wherever he has been led in the right direction. To make the Italian uniformly successful it is only necessary to lead him out into the country, away from the vitiated atmosphere of the tenement and slum. No place is better fitted for him than our southern states, and no immigrant is better fitted for playing a part in the development of those states than the Italian. He requires the pure air of the country and the geniality of the southern winter, and by his skill and industry in intensive farming, he can make the sandy soil of the pine land productive or reclaim the swamps and lowlands, which have lain fallow for years. He can give the southern planter his reliable thrifty labor to replace the erratic improvident negro, and can introduce and carry to perfection the vine growing and wine making, which have made southern California famous. These are some of the possibilities of the Italian immigrant, if properly directed, but his mode of life in the great cities, where the vast majority of Italians lives, presents quite a different picture. Here we find the 'Italian quarter,' which is responsible for most of the prejudice against

the Italian immigrant. In these colonies we see the Italian at his worst, physically and morally, but, as has been pointed out, he crowds the Italian quarter because there is no alternative for him, in his ignorance of our language and customs. Instead of being led into the country, where the labor is needed, he is induced to stay in the 'quarter' by his more fortunate countryman, padrone or banker, who expects to increase his profit thereby.

The philanthropists, Italians or Americans, who will direct the Italian to his proper place in the rural districts, will do a grand work for the Italian immigrant, for the states to which he will contribute his skill and labor and for humanity in general.

The Italians are the principal factor in our Latin immigration, but we also receive French, Spanish, Portuguese and Roumans.

Immigrants from France rank high as desirable additions to our population, but the desirability of French-Canadian immigration has been the subject of much discussion. Much of the disfavor into which the French-Canadians have fallen is due to their effect upon labor conditions in New England. It is estimated that from fifty to seventy thousand of these French-Canadians come to the New England factory towns, for temporary employment, each year. When the price of labor rises they come in large numbers and when the wages decrease large numbers return. It is said that many French-Canadian farmers send their families to Fall River and other New England towns to earn money and return with their savings to Canada. Their standard of living is very low and, as they regard their sojourn as temporary, they make little attempt to better it, but subject themselves to hardship and self-denial in order to increase the amount of money which they hope to take back with them to their Canadian homes.

The enforcement of the child labor laws and the reduction of the number of working hours for women, by the state of Massachusetts, has had a marked effect upon the unfair competition of the cheap child labor and unlimited working-day, which were features of the French-Canadian invasion. Organization of the French-Canadians has been beyond the power of the labor unions, and they are a factor in depressing wages in the textile trades, although the influence in this direction of the competition of native labor in the south must not be overlooked.

The French-Canadians are among the best lumber men and river drivers in the world, and have been valuable in this industry in northern Michigan and other border states. They are not very thrifty, and usually spend their money freely. After the timber is stripped off, they have more inclination to follow the receding timber line and live in the lumber towns than to take up the cleared land for farming.

In New England more of these people are becoming permanent

settlers than formerly, and among those who show an inclination to permanence, the standard of living is improving, in imitation of their English, Irish and American neighbors.

Portuguese immigration in 1903 amounted to over eight thousand souls. They have the highest proportion of illiterates of any European race, their percentage of illiteracy being about 70 per cent. They also bring less money *per capita* than most other races. In spite of these facts, a study of Portuguese immigration reveals many excellent qualities, and chief among these are their permanency, peaceable disposition, thrift and skill in fruit growing and truck farming. The behavior of Portuguese immigrants undergoing inspection at Ellis Island is characterized by extreme gravity and almost absolute silence. They present a striking contrast to the animated vivacious Frenchman or jabbering Italian, and after landing make quiet, law-abiding citizens. About 38 per cent. of the number landed last year were females, and nearly 25 per cent. were children, indicating the large number of families and their evident intention to settle permanently. Their distribution here is peculiar, and 93 per cent. of the total landed last year went to three states, Massachusetts, California and Rhode Island. They are practically the only race from southern, central or eastern Europe which does not send the majority of its immigrants to New York or Pennsylvania. The following table indicates the number and geographical distribution of Portuguese landed in 1903:

State.	Number Landed.	Ratio to Total Number Landed.
Massachusetts	5,691	68 per cent.
California	1,057	12.5 "
Rhode Island	1,029	12.5 "
New York	475	5 "
Connecticut	114	1.5 "
All other states	67	1 "
Total	8,433	100 per cent.

The Portuguese in Massachusetts and Rhode Island are engaged in fishing, market-gardening and fruit growing. They have taken up abandoned farms in those states, particularly in the Cape Cod district, and have been successful in agriculture where others have been discouraged. In California they have been very successful as fruit and vine growers. Their skill in intensive farming enables them to establish themselves upon tracts of land which are unproductive to ordinary agricultural crops and methods, and by truck farming and fruit growing they make a living upon farms neglected by native farmers.

Physically they are undersized, but are remarkably free from disease and physical defects. Seventy per cent. of the males are unskilled laborers, and their natural trend, unlike other southern Europeans, is toward the agricultural districts. Even the Portuguese fishermen

about Cape Cod are giving up this pursuit and taking up farms in that vicinity with their usual success. There is plenty of room for these agricultural Portuguese immigrants in this country, particularly in the south, and their coming will greatly increase the productiveness of any state with waste land, or farms that have been abandoned for a more fertile section.

Little need be said of Spanish immigration, which is small, but of excellent quality. Their total in 1903 was only 3,297. In striking contrast to their neighbors, the Portuguese, they exhibited over $50 *per capita,* and their illiteracy was only 9 per cent. They show less inclination to become permanent settlers, however, than the Portuguese, as evidenced by the small number of women and children among them. A large proportion was made up of merchants, professional men, students, marines and skilled mechanics, and less than 1,000 were classed as laborers.

The Roumanian, or Rouman, immigrants are classed as Latins, and in their appearance and speech resemble that group of peoples. The Roumanian people numbers about 5,000,000, most of them in Roumania. Roumans are also found in considerable numbers in Hungary, Transylvania, Bessarabia and the Balkan states. They are descended from a blended stock, made up of Roman colonists and disbanded soldiers, and the Illyrian and Thracian inhabitants of Macedonia at the time of the Roman conquest (146 B.C.). The whole of Macedonia was, up to the seventh century and the coming of the Slav, occupied by a Latin-speaking race. The Slavic conquest forced the Roumans in great numbers to their brothers north of the Danube, and many were carried farther by the wave of invasion—as far west as the Tyrol. The Roumans in Macedonia are skilled in metal working and the building trades, but we receive comparatively few Roumans from either Macedonia or Roumania. Eighty-five per cent. of our Roumanian immigrants come to us from Austria-Hungary—and they are practically all unskilled laborers. Although classed as Latins and speaking a Romance tongue, they show, in many cases, evidence of fusion with other races, Magyar and Slav. The Rouman type is short and dark, and they are usually free from disease and have a fairly good physique.

They bring very little money—less than ten dollars *per capita*—but, being unskilled laborers, seldom become public charges. They are an industrious people and possess in a marked degree the pride of race common to all peoples of Roman blood. In desirability these various Latin peoples might be rated higher than the Italians, but their numbers are relatively so insignificant that more extended notice is unnecessary.

THREE DECADES OF COLLEGE WOMEN.

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THE following statements relate to the occupations, careers and matrimonial condition of the graduates of the first thirty classes of Vassar College, from 1867 to 1896, inclusive. The records of 1,302 women are included. The information is taken from the last general catalogue, which gives the history of all the classes to the end of the century; but the last four, 1897–1900, are not considered in this article.

The first question that everybody asks is, Do college women marry? The first ten classes, 1867–76, contain 323 members. Of this number 181, or 56.03 per cent., have married. The average age of a college woman at graduation is 22 years. Hence the age of these classes in 1900 averaged from 46 to 56 years—most of the members old enough to be grandmothers. It is quite possible that some of the living members may marry yet, for two instances were found in one class where marriage occurred 24 years after graduation; but making allowance for sporadic cases of this sort, 60 per cent. would probably include the complete marriage record of the graduates of this period.

These figures would seem to confirm the worst fears of those who, forty years ago, opposed the admission of women to college. It is difficult to make comparisons, because so many circumstances enter into the question of marriage. College women come from all sections of the country and from the most diverse social and pecuniary environment. The rate here given is undoubtedly less than that for the whole female population of the country, but perhaps not less than might be expected for a specialized and highly educated class.

The tendency of civilization seems to be toward comparatively late and few marriages. One can almost judge of the advancement of a people as a whole (the isolated villages of Miss Wilkins's stories are exceptional) by the number of single women. Females among savage races, as in the animal kingdom, are not allowed to remain unmated. It is an unusual thing in these days for a well-bred girl to marry under twenty. In our mothers' day such a course was eminently proper, and in our grandmothers' time girls married at fifteen or sixteen and afterwards bore that number of children.

As soon as a country becomes settled and its inhabitants used to material comforts and social privileges, the care and support of a family become a serious matter and early and hasty marriages are

discouraged. Whenever a variety of occupations is open to women, they need not marry for a livelihood and the ethical standard is raised. I think, however, the fact that a woman has an occupation is a less certain hindrance to marriage than many suppose. As will presently be seen from these records, the graduates who have taken up the most advanced work are quite as likely to marry as those who have not, and many of those who are best known to the outside world are both wives and mothers.

Still another fact may comfort the pessimists: Although less than three fifths of the first decade of Vassar women have entered matrimony, no other profession in any decade has attracted nearly so large a number. If marriage is not universal among college women, neither is teaching.

In the second decade, including the classes '77–'86, there are 378 graduates. The members of these classes in 1900, accepting the average age, ranged from 36 to 46 years. As might be expected, the marriage rate is somewhat less than for the preceding decade. Out of the whole number 191, or 50.53 per cent., have married. The next general catalogue would probably show a larger proportion. The third decade, 1887–96, contains 601 members. As '95 was the first Vassar class to graduate 100 members, a rate which since then has been steadily exceeded, it can readily be seen that half the members of this period were under thirty years when the census was taken. Its marriage rate has no value for general statistical purposes. Of the 601 members 169, or 28.12 per cent., were married in 1900.

The number of children next claims attention. These statistics are particularly valuable, for it is the first time any on this subject have been collected. The general catalogues of 1883 and 1890 contain no information on this point. The 181 marriages of the first decade have produced 361 children, or two to a marriage, a typical American family of the present day. In the second decade there are 191 marriages and 295 children, or 1.54 children to a marriage. It is fair to assume that this proportion will be increased. In the last decade there are 169 marriages and 135 children, an obviously incomplete record.

Although the number of children seems small in the first decade, which is the only one where the record may be regarded as measurably established, it must not be inferred that there are no large families among the alumnæ. The banner record in this respect belongs to a member of the class of '75, a widow with eight children. There are three graduates who have seven children each, in the classes of '71, '79 and '80, respectively. The member in '71, a small class of 21 members, 12 of whom have married, has nearly one quarter of the whole number of children (29) in the class. In the class of '79 three

mothers claim 19, or more than half of the 35 children which have resulted from the 18 marriages. In the family of the member from '80 six of the seven children are sons. There are nine mothers who have six children each, one in '69, '73 and '74 and two in '76, '78 and '79, respectively. In three of these families, the one in '69 and one of the two in both '76 and '78, the children are all boys. All this goes to show, what has so often been stated, that there is no such thing as an average person.

Now comes the most surprising fact in the whole record of this catalogue, and that is the preponderance of boys among the children. In the first decade there are 204 sons and 157 daughters, making the excess of the former nearly 30 per cent. At first this proportion seemed accidental, but though not so large in the succeeding decades, it appears constant. In the second decade there are 160 sons to 135 daughters, making the excess of the former 18½ per cent.; and in the third decade there are 73 sons to 62 daughters, or 19⅓ per cent. more boys than girls.

It is a well-known fact that in the normal birth rate the number of males slightly exceeds the females, by about five per cent. This is explained because of the greater mortality among boy babies. It is the intention of nature that the sexes upon arriving at maturity shall be about equal in numbers. But the fact that to any class of mothers should be born nearly one third more sons than daughters, as in the first decade, or almost one fifth more, as in the other two decades, suggests an interesting problem to the physiologist and the sociologist. Climate or material environment can not account for it.

Before leaving these matrimonial statistics, it may be worth while to compare them with those of the Harvard graduates, as set forth by President Eliot in his report of last year, which has not yet ceased to echo around the country. Dr. Eliot gave the records for six classes, 1872–77. Of the 881 members in those classes 634, or 72 per cent., had married. Though the proportion is considerably larger than that (56 per cent.) of the 323 Vassar women in the classes 1867–76, President Eliot considers it regrettably small. It is interesting to note that the average number of children is precisely the same, both in the Harvard and in the Vassar families, two to each. The 634 Harvard fathers report 1,262 living children. College women as a class have often been sneered at because so many of them do not marry, but if less than three fourths of college men marry, perhaps higher education may have an effect upon the individual quite as much as upon the sex.

Of the 1,302 Vassar graduates, 1867–96, there were 541 married in 1900. In the whole list there are but three second marriages, two of them in the class of '81, and no divorce indicated as such. But

one other fact remains to complete this record of vital statistics. In the first decade 63 members, or 19.19 per cent., have died. Of this number 36 were married and 27 unmarried, a ratio of four to three. This might indicate that matrimony is slightly unfavorable to longevity, as the ratio of those marrying to those not marrying is 14 to 11. But this impression is corrected in the following decades.

In the second decade the number deceased is 39, or 10.31 per cent. Of these 16 were married and 23 unmarried, a ratio of about two to three. As the number of married and single women in this decade is about equal, the death rate is decidedly in favor of the married. In the last decade 16, or 2.66 per cent., have died, four of them married, making the rate one to three, whereas the marrying rate is about seven to 18. This again shows a small balance in favor of the married. The whole number of the graduates who have died is 118, or 9.06 per cent.

Next to matrimony the profession that claims the greatest number of the alumnæ of Vassar is teaching. In this schedule are included all those who have recorded themselves as teaching, if only for a year. This may give an exaggerated impression of the number following teaching as an occupation; but I know of no way of establishing a definite professional record for a woman, because all roads, sooner or later, are likely to lead, if not to matrimony, to the domestic circle. From my own observation I should say that probably two thirds of every class at Vassar, immediately upon graduation, experiment more or less with pupils. Members of school boards will probably say that fully three thirds seek positions. My estimate may be more nearly correct, however, and of this two thirds, I doubt if more than one sixth, or one ninth of the whole, follow the profession for a considerable length of time, say ten or fifteen years.

Here are the records: In the first decade 128 of the 323, or 39.62 per cent. of the whole number, are recorded as teaching or having taught. Out of this list 46, or more than one third, have married, which in most cases, not all, has ended their public teaching. Several have resumed or taken up teaching on the death of their husbands, and sometimes when the husband is living. In the second decade there are 154 teachers, or 40.70 per cent. of the whole number. In this list 59, or again more than one third, have married. In the last decade, where we naturally expect to find the greatest number who have not severed their connection with the school-room, there are 304 teachers, or but 50.58 per cent. of the whole list, and even out of this half 52, or 17.10 per cent., were married in 1900.

A considerable number of these teachers have done advanced work. In the first decade there are twenty professors, officers and instructors in institutions belonging to the Association of Collegiate Alumnæ, an

organization which admits no colleges but those of the first rank. There are fifteen professors and instructors in other institutions. There are also thirteen principals, either of their own private schools or of endowed academies. This makes a list of 48; excluding ten duplicates, 38, or nearly 30 per cent., of the 128 teachers are of collegiate or principal rank.

This proportion of advanced rank holds good in the second decade, which contains 28 professors and teachers in colleges belonging to the Association of Collegiate Alumnæ. There are 21 professors, officers and instructors at other colleges and seven principals and preceptresses. Of the 56 just mentioned, excluding 11 duplicates, there are 45, or more than 29 per cent., of the 154 teachers of this decade, of collegiate or principal rank.

In the last decade it is not surprising to find that no graduate has yet attained to a professorship in a college belonging to the Association of Collegiate Alumnæ. There are, however, 26 teachers in the Association of Collegiate Alumnæ colleges, one principal and 14 professors and teachers in other colleges. These 41 instructors make 13.48 per cent. of the 304 teachers of this decade.

Next to imparting knowledge Vassar alumnæ seem to be fond of acquiring it. After the teaching profession no occupation or pursuit enlists so many graduates as that of advanced study. In the first decade 35 have taken the degree of A.M.; three, that of S.B.; and two, that of Ph.D. The strictly professional degrees will be mentioned later. There are also three fellows and three who have done graduate work at universities without degrees. Excluding ten duplicates, 36 members of the first decade have done graduate work. This is 11.11 per cent. of the whole number for this period.

In the second decade 29 have taken the degree of A.M.; one, that of S.B.; one, Ph.M.; and six, Ph.D. There are also two fellows and six who have pursued advanced studies at universities without taking degrees. Excluding ten duplicates, 35 members of the second decade, or 9.26 per cent., have done graduate work at colleges and universities.

In the third decade 36 have thus far taken the degree of A.M.; thirteen, that of Ph.D.; there are eight fellows and 42 advanced students. The Ph.D.'s are accredited as follows: Yale, 4; Cornell, Chicago and Bryn Mawr, two each; University of Geneva (Switzerland), Columbia and Harvard, one each. The last is recorded, not granted, as Harvard University, almost alone among the colleges of this country, does not yet confer degrees upon women. Excluding 13 duplicates out of the foregoing 99 names, 86 alumnæ of this decade, or 14.31 per cent., have done graduate work at American and foreign colleges and universities. In the class of '91, numbering but 36 members, there are five Ph.D.'s, almost one seventh of the whole.

The average of those doing graduate work for the whole thirty years is 12.05 per cent. The large proportion in the last decade is due, not so much to increase of scholarly ambition among the alumnæ of Vassar as to the fact that men's universities in America did not afford post-graduate study to women until the nineties. The first Ph.D. received from a great university by a Vassar woman came from Yale in 1894. The two women in the first decade who are Ph.D.'s did not attain that degree till about twenty years after graduation.

Next to imparting and acquiring knowledge from the teacher's desk the greatest desire among Vassar women appears to be to inform the public through the medium of printers' ink. The contributors to periodicals number 23 in the first decade, 25 in the second and 31 in the third, a total of 79. The writers of miscellaneous publications are 6, 20 and 22 for their respective decades, a total of 48; and the authors are five, four and five for the same periods, a total of 14. The combined lists make 141, or 10.83 per cent. of the whole number of graduates. In this entire register there is no name that would be instantly recognized by the general public, but the publications in the mass represent a very considerable amount of creditable and successful work. The periodicals to which so many contribute include journals of various rank. There is no important magazine or paper in this country, popular, literary, critical, political, scientific or religious, except possibly some technical journal of very limited scope, which does not number Vassar women among its contributors. Their names have appeared in some foreign periodicals as well.

In the next department surprise may be expressed at the lack of quantity. It seems strange that the medical profession does not attract more college women. As medicine is the only one of the so-called learned professions which women have entered in considerable numbers, and as it is a most honorable and lucrative one, it would be expected to appeal strongly to women graduates who are looking for a career. The only explanation seems to be that women who are attracted toward the healing art may not have the time and money for a preliminary college course. As the medical schools are constantly raising their requirements, this condition will probably be changed in time.

In the first decade twelve Vassar women have taken the degree of M.D., two of them at foreign universities. Of these nine are registered as physicians. In the second decade fourteen graduates have taken the degree of M.D., two at foreign universities. Of these twelve are registered as physicians. In the third decade there are so far twelve M.D.'s, ten of whom are announced as physicians, one being a missionary physician to China. There is also one medical student.

The total number of those taking a medical degree is 38, or a little less than three per cent. of the whole number of graduates. The num-

ber of practising physicians is 31, or about one for each class. This number is, however, quite irregularly distributed, the classes of '77 and '93 having four and some others two each. As there are twelve M.D.'s in the first and in the third decades, while the number of graduates in the latter decade is almost double that in the former, it would seem at first sight as if the rate of those studying medicine must be steadily declining. It is hardly probable, however, that such is the case, for the third decade contains so many who have recently graduated that it is of little value for statistical purposes.

The literary writers have already been mentioned. A few alumnæ have done good work as writers of text-books or of scientific papers. There are fifteen writers of text-books, eleven in the first, and two each in the second and third decades. The fact that nearly three fourths of the writers belong to the first decade seems to show that it requires considerable experience as well as maturity of mind to write a text-book. This apparently does not hold when it comes to publishing scientific papers; researches are quite as likely to be conducted by recent graduates.

There are four writers of scientific papers in the first decade and their subjects are astronomy, logic and mathematics, chemistry and mineralogy, wasps and spiders. There is one writer in the second decade (biology) and five in the third decade—two writers on astronomy and three on what the present writer fondly believes are biological subjects, but is not sure. For instance, 'Dinophilus Gardineri'; is it a mastodon or a microbe?

It was hoped by considering the miscellaneous occupations in decades to discover some tendency of the times, some drift of educated women toward new work, but this is observable in but two or three instances. Though there are many more kinds of work registered in the third decade than in the first, there are some occupations in the first decade that are not filled in the others, showing that much depends upon the individual. Again, women of the first decade often entered into modern pursuits in middle life. Thus library work, which has only recently become a profession, has drawn graduates of all ages.

In the list of librarians, cataloguers and assistants there are five in the first decade, four in the second, eight in the third. There is also a student in a library school from the first decade and two students from the third decade. Among the 17 already in library work several hold or have held positions in colleges, Columbia, Vassar, Wellesley, Bryn Mawr and Bates. Most of the librarians are of comparatively recent training, but in the first and second decades the work has often been undertaken after years of teaching. In the third decade it is usually begun immediately upon graduation, showing that as a possible profession library work is assuming increased importance in the eyes of the undergraduates.

The two occupations in which the increase of recent graduates is most noticeable are secretarial or clerical and philanthropic, notably college settlement, work. Of the 18 secretaries, there are three in the first decade, three in the second and 12 in the third decade. Several of these hold positions in colleges. Philanthropic work as a profession belongs wholly to the second and third decades. In the second decade are four graduates: three missionaries, two to Japan and one to India, and a Salvation Army worker; in the third decade are eight: five settlement workers, including one head resident; one missionary to China, one district agent of organized charities and one assistant secretary, State Charities Aid Association, making twelve in all. This list includes those only who seem to be devoting their whole time to the work; hence many holding prominent offices in the Women's Christian Temperance Union and various missionary organizations are not mentioned.

Under the somewhat liberal term of executive work are grouped three members of the first and three members of the second decade, though the members of the first might almost be classed in the philanthropic list. They are the matron of a reformatory home, the manager of a children's home and the secretary of a Young Women's Christian Association. In the second decade are an assistant to the lady principal of Vassar, a bursar of Barnard College and a worker at Pratt Institute.

Music and art have attracted eight graduates each. The artists are four in the first, and two in each of the other decades. Some of these have attained more than local note. The musical people are thus divided: In the first decade are two organists; in the second, an organist, a concert pianist, a professional singer and an assistant supervisor of music, New York schools; in the third decade are an organist and a professional accompanist; making eight in all.

It may surprise some readers to know that eight of the graduates have engaged in agricultural operations. In the first decade two are registered as farmers, a third as a dairy farmer and a fourth as manager of the Kingwood herd for the making of sterilized milk; there is also a fruit grower. In the second decade are a stock farmer and an orange grower. In the third decade is a rose grower. Let us hope that these educated women may wrest wealth as well as health from their contact with the soil.

Five graduates have engaged in business, three in the second and two in the third decade. In the second decade two are managers of manufacturing concerns and one is in the lumber business. In the last decade one has been business manager of a newspaper and is treasurer of a publishing company and one is in the jewelry business.

Vassar has always had a decided leaning toward astronomy, due

probably to the influence of Maria Mitchell, who for nearly a quarter of a century made the college observatory her throne room, whence her magnetic personality radiated far and wide. Here was trained her able successor, Professor Mary W. Whitney, '68. Besides those teaching astronomy, who are included in the general list of teachers, and those who have published astronomical papers, four have engaged in other forms of astronomical work. In the second decade one has been a computer at the Yale observatory; in the third decade are three, a lecturer, for six years worker at the Harvard observatory, a computer at the Yale observatory and a computer on the Nautical Almanac.

No Vassar woman has yet been ordained a minister, but the legal profession is beginning to attract a few graduates. There are three in the third decade. A member of '88 has taken the degrees of LL.B. and LL.M., was admitted to the New York state bar in 1895, and is registered as a lawyer. She is also married and has two children, but her marriage occurred previous to her legal studies and soon after graduation from Vassar. A member of '89 was admitted to the Illinois bar by examination in 1896, and was thereupon married. She has one child. She is not registered in the catalogue as a lawyer, but she has published the 'Municipal Code of Macomb, Ill., Revised and Codified.' A member of '95 is registered as a clerk and student in a law office in Chicago. Besides these three, two Vassar women have acquired the degree of LL.B., evidently for the purpose of general culture and not for legal practice. In 1887 the honorary degree of LL.D. was conferred upon Mrs. Christine Ladd Franklin of '69 in recognition of her attainments in mathematics and logic.

We now come to the twos and ones. In the first decade are two bookkeepers; in the second decade, two lecturers; in the third decade, two regents' examiners for the state of New York. A chemist is catalogued in the first and in the third decade, and a water analyst for the Massachusetts State Board of Health in the second. Two graduates have undertaken nursing, one in the second decade becoming a trained nurse; and one, Miss Reubena H. Walworth, '96, acting as a volunteer nurse in the Spanish War, dying in the service of her country. In the second decade are a draughtsman, a government clerk and a life insurance agent; and in the third decade are a translator from the French, an actress, a kindergartner, a canvasser, a director of a gymnasium, a director of a domestic science department, and a promising student of chemistry who has been an assistant, lecturer and docent at the University of Geneva, Switzerland.

An unusual record is that of a member of '83, a young woman of brilliant literary gifts, who chose the life of a Salvation Army worker. After laboring for twelve years amid the slums of London and attaining the rank of Major, she became converted to the Roman Catholic

faith, returned to New York, and in 1900 entered the novitiate of the Dominican Sisters at Albany. Another individual career is that of Miss Stematz Yamakawa, '82, the only Japanese girl ever graduated from a college. Upon her return to her native land she married the Marquis Iwao Oyama, a field marshal commanding the second army of the empire. Closely associated with the Empress, and the only Japanese woman of rank familiar with occidental civilization, she has had a wide social and educational influence in her native land.

The amount of club, philanthropic and general educational work done by the graduates of Vassar has never been computed. As members of school boards, trustees of various colleges, organizers and directors of important societies, officers of charitable institutions, their influence has been felt in every part of the land. Happily, work of this kind by educated women is now so common as to call for little comment. If the college has as yet produced no famous genius, it has sent forth more than 2,000 daughters (2,332 in 1904) with well-trained minds, accompanied in most instances by sound bodies, who have quietly and gradually helped to raise the status of women wherever the English language is spoken or read.

DEXTRALITY AND SINISTRALITY.

By Dr. GEORGE M. GOULD,
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THE theories that have been advanced as to the origin of dextrality and sinistrality are:

1. A natural provision. (Sir Charles Bell, and others.)

2. The left-sided location of the heart. (Referred to by Wilson.)

3. A greater supply of nerve force to the muscles because of an earlier and greater development of the brain upon one side. (Professor Gratiolet.)

4. Obstruction to the flow of blood in the vena cava, by the pulsation of the aorta. (Dr. Barclay.)

5. Inspiration produces, mechanically, a superior efficacy of the muscles of the right side. (Professor Buchannan.) This theory is based upon the observation of the anatomic peculiarities of the liver, lungs, etc., and their supposed influence upon the center of gravity of the body. (So far as pertains to the center of gravity, the theory has been adopted by Dr. Struthers and by Dr. Allis.)

6. The center of gravity theory. The influence of the weight of the viscera of the two sides of the body, upon the position of the center of gravity. (Dr. Struthers, accepted by Buchanan, Allis, etc.)

7. The origin of the subclavian arteries, the left before the right in the left-handed, with superiority of blood-supply to certain structures. (Professor Hyrtl.)

8. The development of one cerebral hemisphere more than the other. (Wilson.)

9. The Topsy theory—'just growed.'

These theories merit little argument in rebuttal. No. 3 and No. 8 are essentially the same, and, of course, are mere avoidances of an explanation. No. 2, No. 4, No. 5, No. 6 and No. 7 are not based upon facts, and contain fallacies of observation, rendering them at least of insufficient reach and validity. No. 9 is almost as good as any or all of the rest, and we are left with the frank confession of Dr. Struthers, that the mystery 'has baffled satisfactory explanation.' Carlyle said it was 'a question not to be settled, not worth asking except as a kind of riddle.' It is, however, of great and practical importance in medicine and in social life.

In a large way and notwithstanding a certain number of exceptions, it is an illuminating truth of biology that 'the ontogeny repeats the

phylogeny.' We can, therefore, never explain the phases of development through which an organism passes except by knowing the corresponding stages of evolution of the line of its ancestral forms. If, therefore, we ever solve the mystery of dextrality and sinistrality, it will be by the study of the conditions, habits, necessities, etc., of the ancestral types when dextrality and sinistrality arose. The infant of a few months shows no signs of preference in the use of the hands; it is not yet dextromanual, nor ambidextral; it is simply nondextrous, or ambisinistrous. Almost as soon as it exhibits any conscious effort toward skillful use of the hands it begins to show signs of dextromanuality. Before it walks, before it is one year old, dextrality is clearly pronounced. Baldwin (POP. SCI. MO., Vol. XLIV.) has demonstrated experimentally that it is plainly established as early as the seventh or eighth month. The period in phylogenous savage life to which this of the infant corresponds must, therefore, be that of the earliest phase of humanization. The animals, even the anthropoid apes, do not, so far as I have observed, exhibit it. Vierordt says that parrots grasp food with the left foot, by preference, and that lions strike with the left paw. Livingston is quoted as thinking 'all animals are left-handed.' I suspect this is all error, because, as a rule, it would disadvantage rather than help in the animalian struggle.*

Since any sort of consciousness of the facts has existed the wisdom of dextromanuality has been emphatically exhibited: (1) In the word *dexterity,* which is the prized and honored quality of savage and civil-

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* In the comparative absence of interest in these subjects there is a resultant dearth and awkwardness of words describing the conditions. It seems necessary to coin a few in order at least to avoid more cacophanous ones. The following, some of them already listed in the dictionaries, may be found useful in future discussions:

Dextral, pertaining to the right side of the body.

Sinistral, pertaining to the left side.

Dextrality, Sinistrality, the corresponding abstract qualities.

Dextrad, Sinistrad, toward the right, or left, respectively.

Dextromanual, Sinistromanual, dextrality and sinistrality, respectively, as relating to the hands.

Dextropedal, Sinistropedal, as relating to the feet.

Dextrocular, Sinistrocular, as relating to the eyes.

Dextraural, Sinistraural, as relating to the ears.

Dextrocardial, Sinistrocardial, as relating to the heart.

Dextrohepatal, Dextrosplenic, etc., may be formed.

Dextrocerebral, located in the right cerebral hemisphere.

Sinistrocerebral, located in the left cerebral hemisphere.

Dextrorse, turned, turning, or moving to the right.

Sinistrorse, turned, turning or moving to the left.

Sinistrous, awkward, unskilled.

Dextrous, skilled, expert.

Ambidextrous, equally skilled with both hands.

ized man; (2) in the secondary meaning of the word *sinister*—unlucky, ill-omened, evil; (3) in the persistent training of all left-handed children, by parents, teachers, etc., to make them like the rest of the right-handed world. These three facts, the residue of the psychologic habits of ages, persistent in all history, crystallized and embedded in the very language itself which chronicles all mentality, help to give us the clue to the solution of the riddle.

Skillfulness, 'handiness,' expertness of sense and act, were the sole means whereby the savage could win his place in the world, domesticate animals, conquer in all sorts of conflicts, supply himself with food, clothing, house, etc. It was necessary that one hand should be chosen to do the dextrous or more skilled tasks, for the simple reason that exercise develops and perfects function, and one would learn to be more skilled and 'handy' with one hand than with both. The savage required no treatise on logic nor even any conscious reasoning to teach him this primary lesson. His food and life depended upon his learning it.

But that it was an acquirement, that the law and necessity were not exceptionless, that it was due to no absolute fatalism of anatomy or physiology, is evident from the fact that so large a proportion of left-handed children and adults exist in all races and times. The education of left-handed children, whereby their writing center, naturally dextrocerebral, is by forced training and long habit transferred to the left cerebral hemisphere, is another demonstration that no inherent neurologic or psychologic law governs the location of the cerebral center or its peripheral outworking. When the occasions arose in the humanization process, and the demand for the differentiation of cerebral mechanisms was made, the plastic brain on either side could take up the work. And pure, or untrained, left-handed persons are to-day as expert as their right-handed fellows. All that is needed to explain dextrality in 98 per cent. of children is some ancestral savage custom, habit, or necessity, widely prevalent, which inclined to the use of the right hand and eye for one or two exceptionally intellectual tasks. The inheritance of aptitude, the force of custom, and the necessities of the struggle for existence would certainly fix the persistence of dextrality.

We must not forget that the somewhat sudden and clear preference of dextrality and sinistrality of the child of to-day was in the far-away ancestral line spread out over long periods of time. A year or two of the child's life represents thousands of years of slow acquirement and habit.

Again, it should be remembered that even in our preferences and habits it is only in a few things that one hand, etc., has the greater expertness, accuracy and rapidity. It is often rather a division of

functions, a differentiation of ability, than a unique one. In the dextral the left hand does many tasks of as great or greater importance, and with equal or superior skill, as the right. In eating, the fork is now more used than the knife; in gunning, the left hand is given the vastly more important, difficult and onerous task; in chopping, hoeing, shoveling, picking, lathe-work, railway locomotive engineering and other tasks the left arm and hand often execute the chief and more expert tasks. Especially noteworthy is the playing of the violin, 'cello and bass viol. The 'fingering' is done with the left hand, and forms a striking reversal of dextrality, because it is by all odds the function requiring more manipulative skill, accuracy and rapidity. I do not know that the fact itself has ever been observed and stated, but certainly the reason of this strange contradictory practise has hitherto escaped the attention. It is, I think, due to dextrocularity. With few and easily explained exceptions dextromanuality is a result, or a concomitant, of dextrocularity. If the violin, 'cello and viol were fingered with the right hand the learner would be greatly handicapped by the foreshortening which would exist as his dextral eye glanced along the neck of the instrument straight in front or below this eye. The learner must see his fingers and gain precision in placing them by careful visual estimates. But when placed sinistrad the right eye sees the neck of these instruments and the fingers at an angle which permits more accurate observation, estimates of distances, etc., than would be possible if the instrument were fingered with the right hand. In those instruments necessarily held in the median line, some wind-instruments, the flageolet, hautboy, etc., the right hand asserts its selective and more difficult task. When the hands are not seen at all, as in the flute, fife, etc., the right again has its choice. No pupil with sinistromanuality established can learn piano-playing easily. I know of one who was a great lover of music who failed utterly after long perseverance.

There are other cautions to be emphasized relating to the acquirement of dextrality by the savage: Nearly all the actions which we now call right-handed were in primeval times to him unknown. This is especially true of three things. Knives and forks have only been used in eating for a few hundred years. He ate with his fingers, and one may suspect he used the left as much as the right in this way. The Mussulman custom and its reason are, of course, both modern. Secondly, the modern gun and revolver had not been devised. The bow and arrow, the spear, boomerang, club, etc., could be used as well with the left hand by the sinistromanual. Thirdly, writing was unknown, or relatively so, and, as we have now learned, that locates the speech center in the cerebral hemisphere opposite the writing hand. It is thus evident that dextrality in the savage, at the time when it

began to become habitual, must have been at best only partial, incomplete, and for a very few acts. The left-handed arrow-chippers, basket-weavers, club-wielders, sewing-women, etc., even if more numerous relatively than in civilized life, would perhaps attract little or at least less attention than now, and would be less discouraged, surely less taught to reverse the natural inclination.

In default of systematic banding and military training, also, the left-handed spearmen, bowmen, swordsmen and clubmen might not have much attention directed to themselves and sometimes might have an advantage over their single and dextral adversaries, *e. g.*, in tilting. The preference in heraldry for dextral quarterings, etc., is by no means uniform.

But there was one overlooked factor which was doubtless decisive in setting up the trend toward dextrality. This was the development of sign-language synchronously, and even preceding that of spoken language. The ineffaceable relics of this long and arduous period exist in present day language, plainly in many savage tribes and customs, but the most striking proof is displayed in our so-called Roman numerals. The fingers of the hand held up, or counted off, were beyond question the beginnings of arithmetic, the means of barter, the method of stating the fundamental fact of number requisite in all thinking and doing. Military and intertribal dealings, especially made the custom powerful and even sacred. One finger was the origin of our figure *one,* the second equaling *two,* etc., up to five, or V, which fork was made by the thumb stuck up opposite the first I. When the counting was more than five, the other hand was made to represent the first five, the digits being added up to ten, when two forks were used, or the crossed thumbs, which constituted X., or ten.* The impressive ceremonies of warring and bartering tribes would stamp with distinctive approval the hand used in the sign-language, and henceforth it would become the honored one, the stamping and writing hand, and in time the sword-hand. The right was chosen as the sign and numbering hand because the left was naturally used for the highly important task of guarding the sinistrally-placed heart with the shield. War is the substance of all early history and of the savage aeons which preceded all history. Dr. Flint (*The Sun,* April 17, 1904) says that deaf-mutes may have an aphasia that prevents the use of the right hand in the sign-language.

Speech is the sole example of the higher functions, sensational or motor, which is single. Feet, legs, arms, hands, vision, hearing, all

* It does not matter with which hand the first numbering, in some cases, was done; the intelligent attention must have been directer to the action with the dextral or spear side. Homer and the earliest Greek vases show the right was *ἐπὶ δόρυ*, the spear side, and *ἐπ' ἀσπίδα* the shield side.

are dual in nature, requiring dual centers of coordination and innervation in the two halves of the brain. But speech, being a single function, can have but one center, and that, of course, must be located, not in any median place, because there is no such place, but in one or the other side. We also know by physiology and pathology that in the dextral it is in the third left frontal convolution, and in the sinistral it is in the corresponding position on the right side. We know, furthermore, that it is the intellectual act of writing, rather than the grosser acts and functions, which localizes the speech center. A man may be left-handed for everything but writing and the judgments issuing in the correlations of spoken words are formed and innervated from Broca's convolution. Or *vice versa* in the case of the sinistromanual writer who is dextromanual for all other acts.

The reason why dextromanuality, dextrocularity, etc., must coexist with sinistrocerebrality becomes manifest. The function of speech or writing is the method whereby judgment or volition passes into action. The initial, dominating and guiding motility to vocal organs, to hand, and even to foot, springing from closely contiguous, and hence more quickly and accurately acting, cerebral centers, will be better correlated and certain than if the centers were in opposite cerebral hemispheres. The indicator of all action, the very creator of intellect, is vision. Hence all right-handed people are also right-eyed.* The centers for right vision, right motion, and for speech are thus in close relationship and upon the same side of the brain. As I have said (*Science*, April 8, 1904):

> The unification and perfection of innervation and cerebration must be better if initiated and executed with the cerebral centers mainly upon one side of the brain, than if the unity is gained by means of the longer and more distant commissural fibers extending between the two sides of the brain. In the right-handed the speech center is in the left side of the brain, as is also the motor center for the right hand, and the optical center of the right eye. The dependence of all motion upon a perfect correlation of vision and judgment needs only to be mentioned. That all intellect is psychologically the product of vision is less recognized, but is not less absolute truth. The right hand writes, possibly because the right eye looks down upon the writing more accurately than would the left; both depend upon the synchronous and

* One of the best tests of predominant dextrality or sinistrality is the 'sighting' of a stick to see if it is straight, or the sighting of a gun or pistol. Dextrocularity is largely a dictator of general dextrality. And of dextropedality also, for the dextral is right-footed also. Errors of judgment, however, have been frequent as to the function of the feet. The 'spade-foot' is the left, naturally, because the right leg and foot are the directing ones, in the dextral, who also, as the masonic ritual directs, steps off with the left foot first. The dextral must spring from the right foot. It has been said that the oblique line of the body of the dog in trotting is due to incipient right or left-footedness. But all soft-footed animals avoid 'interfering' by this obliquity of progression. The much discussed knockout blow of the pugilist with the left is, I suspect, because of the better spring from the firmer right foot.

closely interrelated guidance of the speech-making function. All three are in closer unity and contiguity than if either were in the opposite side of the skull.

This furnishes the physiologic reason why all attempts at ambidexterity are failures, and unwise.

The chief centers most closely interrelated in writing and thinking are thus demonstrably better harmonized when in one side of the brain. The mechanics of neurology are plainly less difficult than could be achieved by any foolish and unsuccessful ambidexterity. I have never seen anything but bad results from the attempt to train children to use the right hand instead of the left, when there is a decided tendency or habit to be left-handed. Moreover the attempt is never successful. The best consequences are poor, and are only awkward mixtures of the two forms, which yield confusions and indecisions during the entire subsequent life. I could cite many instances in proof, some of them most pathetic, in which disease and life-failure resulted. One that plainly illustrated the neurologic troubles was that of a naturally left-handed friend, A. V. P., who by arduous and continuous training during his childhood was compelled to write with his right hand. For all other acts he is left-handed, but he can not use his left hand for writing. Although now past fifty he has always hated any writing, the mere act of doing so, and he can not do any original thinking while writing. He is for this purpose compelled to rely on a stenographer, and then his ideas flow freely and rapidly. If he tries to think, plan, or devise and to write at the same time there is a positive inhibition of thought and he must make sketches, epitomes, several efforts, copyings, etc., in a painful and most unsatisfactory manner. The attempt at ambidexterity has been a lifelong obstacle to him in his professional progress. The ambidexterity of surgeons, artists, etc., is overpraised, exaggerated, and fallacious. It is of course advisable in exceptional callings and actions to cultivate skill in the more awkward hand, but that is a very different matter from 'ambidexterity.'

All agree that perfect ambidexterity has never existed, despite all training. It is neither possible nor desirable.* Sinistrality is no defect and of no disadvantage. That said to exist in criminals, idiots, etc., like many things 'Lombrosal,' is not true, or it is *post hoc,* etc.

It seems that there is an 'Ambidextral Culture Society' in England which, in default of something to do of use and in accord with nature's indications, wishes to insure that every child at school shall be so drilled in both separate and simultaneous use of the two hands that he shall have the two equally strong, sensitive and skillful. The pitiable victims! The organization might better call itself the society for nullifying the law of the differentiation of function necessary to all progress, for returning to barbarism in the handicrafts, and for life-long cruelty to the left-handed.

The essential and clarifying thought of the foregoing explanation is that as the writing act now locates the speech-center, although all other acts may be opposite-handed, so the right-hand sign-language and numbering would necessarily have had the same effect in barbarous

* See the case of Morse, reported by Wilson; especially his own, and that cited on p. 146.

times. That this sign-language of primitive man was dextral is not to be questioned, as about 98 per cent. of babies are now clearly right-handed before they are one year old. The protection of the heart by the shield would constitute sufficient reason for the institution of dextrality in counting and sign-making, and custom and uniformity of habit especially in early times, would result in almost a universality. But not an absolute one, for one or two per cent. are now sinistral. And the Bible story of the Benjamite tribe illustrates how the habit would not be absolute. There is in all this one noteworthy neurologic fact: In view of the long continuance and vast preponderance of dextrality it seems strange that the brain preserves all the preformed mechanisms, plastic and ready to make a sinistral child, and the out-working of sinistrality is as prompt, the result as dextrous, as if dextrality had been chosen. The wonder at this is, however, lessened when one notes that all the functions of completed dextrality are at the same time and in the same person now possible to the sinistral; there is a mere difference in the degree not in the kind of expertness. Besides this a number of left-handed acts in the dextral, *e. g.*, those of the violinist, gunner, etc., are far more expertly and finely coordinated than those of the right, etc.*

If the foregoing explanation of the origin and perpetuation of dextrality is adequate, it remains to explain the origin of sinistrality. Why are there about two out of a hundred naturally left-eyed and left-handed? Fundamentally, of course, because the speech-center is located in the right cerebral hemisphere, and the contributing and executing centers of vision and motion act in better unity if they are in close connection and contiguity than if connected by long commissural fibers to and from the opposite sides of the brain. The dextrocerebrality of two per cent. of sinistral exceptions to the usual law appears explainable, perhaps in part by persistence of original sinistral types, but more certainly they are due to accident, injury, disease, etc., of dextral organs, in the young of our ancestors. Especially in savage life would these accidents be more numerous than now. The loss of even one dextral finger might compel the education of the undeveloped speech center on the right side. Injury to the right hand and arm, even of the right foot or leg would do the same. Deafness of the right ear would compel a turning of the left ear forward and might work out complete sinistrality. But more important than all these causes combined would be the more frequent greater ametropia, amblyopia, dis-

* There is thus no danger and no need of a greater weight of the half brain initiating dextrality in the dextral, and all the discussion and labor of comparative weighing the two halves is relatively useless. Moreover the cerebral mechanisms must be equally perfect even if not equally exercised. Taken in the average the two sets of organs, central and peripheral, do about the same amount of work.

ease, leukoma, etc., of the right eye, compelling the use of the left, and thus transferring all centers of dextrousness to the right side. I have repeatedly demonstrated the persistence of dextrocularity even with visual acuteness considerably less than that of the left. But there is a limit to this 'accommodation,' and if the amblyopia of the right is greater than double that of the left, the patient becomes left-eyed. In savage and in semicivilized life these accidents, diseases, ametropias, heterophorias and strabismuses of the right eye would again be far more numerous than in our day and civilized peoples. Our two per cent. of sinistral children seem for the greater part to be the descendants, by the laws of heredity, of ancestors who in childhood and youth have been compelled to become sinistral by the causes enumerated.

Is it possible that there are proportionally more left-handed among oriental nations who read from right to left, than in those who read from left to right? A writer in the *Cornhill Magazine* (1889) says that the change in writing whereby the proceeding from right to left was reversed was due to the use of ink and pigments in writing, and the avoidance of smearing the fresh-writing by tracing the letters from left to right. But individual writers would not do this, and, if they did, they could not get their writing accepted! It is difficult to see how there would be less smudge and smear by the reversal.*

The arguments for upright writing are incontestably strengthened by some facts I have lately discovered as to the frequent influence of an axis of astigmatism in the dominant eye varying by about 15° from 90°, in producing a habitual canting or sideways inclination of the head. This habitual cant of the head is often followed by spinal curvature. Probably most spinal curvatures are produced in this way, and the number of cases is much greater than is supposed. Such a patient can see upright lines, which predominate over all others in civilized life, especially in those who read much, only by holding the head to one side. When the axis of astigmatism is about 75° the head must be canted to the right to see plainly. When it is 105° it must be canted to the left. Slanted handwriting is itself pathologic, or produces pathologic results of many kinds. The printed letters of the alphabet should be refashioned to avoid all lines except the vertical and horizontal. This would greatly conduce to lessening of ocular and neurologic labor, and would increase ease and celerity of reading.

* This writer says that artists paint from left to right, that the spectator views the paintings of a real landscape in the same way, etc. Even corkscrews, buckles, buttons on clothing—men's, he says, not women's—are for the right-handed, and asks, *why?* The figures on the faces of our clocks and watches are traced to the same cause; but he forgot that the clock face is the modified sundial made round, the location of the shadow of the meridional instant line, dictating the placing of the figure 12, and of all the related ones of the day.

Almost the only letters that could not be thus remodeled and bettered are *V, Z, X,* which are little used. *K* and *R* also require some slanted strokes. The others could all be made up of vertical and horizontal lines. The vast majority of astigmatisms cluster about axes 90° or 180°, and those which are anomalous and unsymmetric produce disease unless corrected, as they may be by proper spectacles.

The summary of the foregoing theory of the origin of dextrality and sinistrality is:

Modern pathology has demonstrated that the intellectual acts of writing and reading locate the speech center upon the cerebral side opposite the writing hand.

The centers for vision, audition, and motion of the hand and foot for correlated dextral or sinistral actions and sensations, are in the same side of the brain.

Coordination of sensation, perception, judgment and act are rendered more accurate, expert and quick by this close contiguity and inter-relationship than if made by commissural fibers from the other cerebral hemisphere.

The original location of the speech center in the dextral was caused by the almost universal employment of the right or spear-hand in sign-language preferred to the left or shield-hand, because this was more restricted in movement by holding the shield over the heart.

The origin of left-handedness was in large measure due to the location or education of the speech center in the right brain because of injury to dextral organs, but chiefly to disease or deficient vision of the right eye.

Ambidexterity of any general or thoroughgoing kind is neither possible nor desirable, and the attempt to bring it about results in suffering and disease.

Vertical handwriting, and printed letters made up of vertical and horizontal lines, should be encouraged.

THE LAKES OF NEW ZEALAND.*

By KEITH LUCAS.

IT is difficult to make general statements which will sum up any points in the morphology of the lakes of New Zealand. This difficulty arises in the main from the strange heterogeneity of the lake-basins. It would be hard, for example, to find any points of resemblance between two lakes such as Taupo and Wakatipu. In the latter the lake-basin seems to be an integral part of the surrounding country; its slopes continue the slopes of the mountain-sides. It is a mountain valley filled with water, and if it were drained dry it would scarcely appear in any way remarkable. Contrast with this the basin of Taupo. It is a trough abruptly sunk in a country which seems wholly unprepared to receive it. The perpendicular cliffs which form its western shore drop suddenly down from among hills whose slopes are comparatively gentle; in one place the cliff even forms a clean section through a large hill, cutting it from base to summit with a perpendicular face over 1,000 feet in height.

In their relations to the surrounding country, Manapouri may be classed with Wakatipu, and Rotoiti with Taupo. In the former group there is a correspondence between the position of the deepest water and the gradient of the land in the immediate nighborhood; in the latter group no such relations can be traced. In Wakatipu the greatest heights combined with the steepest gradients are those of the Remarkables and Cecil peak, and between these the deepest water lies. In Manapouri the same conditions are fulfilled by the Cathedral peaks and Cone peak. The existence of this relation indicates a rough correspondence in type between these two southern lakes and such familiar types as the lakes of the English Lake District.

A further point of similarity between Wakatipu and Manapouri is the presence in each of a large flat area where the water is deepest. This peculiarity of form is not to be confused with the tank-like form of Taupo. In the former, sloping sides lead down to a level floor, which marks the limit of depth; in the latter, perpendicular sides lead to a level floor, beyond which there is a further slope to the deepest point.

In Lake Taupo, the steepest gradient leading to the highest point is found at Karangahape, on the western shore, but the deepest water lies in the northeast part of the lake. In Rotoiti there is a similar

* Conclusion of an article in the *Geographical Magazine* for June.

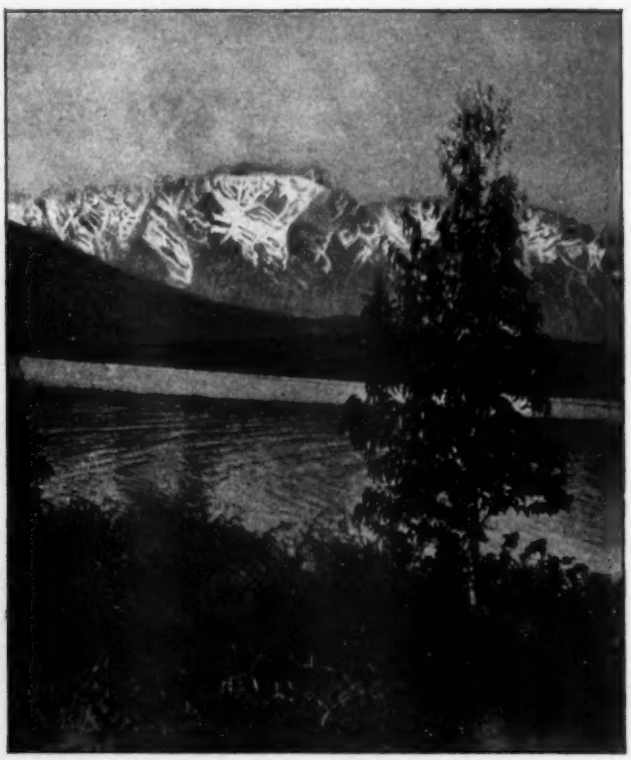
WALTER PEAK, AND PART OF CECIL PEAK (ON THE EXTREME LEFT), SEEN FROM QUEENSTOWN BAY, LAKE WAKATIPU.

LAKE MANAPOURI, LOOKING NORTH-WEST FROM THE MOUTH OF HOPE ARM. POMONA ISLAND IS SEEN ON THE LEFT, AND BEYOND IT LIE THE CATHEDRAL PEAKS.

lack of correspondence between Matawhara, at the east end of the lake, and the deep water which lies some distance to the west of it.

The two lakes Taupo and Rotoiti have in common a tank-like form of basin. It is also possible that a relation between the two may be indicated by the presence in each of isolated banks or shoals. Examples of such shoals are found in the west end of Rotoiti, and in Taupo between Karangahape and the island Motutaiko.

The remaining lakes form a very heterogeneous lot. Rotorua is a saucer-like depression, a mere continuation of the whole catchment basin in which it lies, regular in its outline and in its subaqueous slopes. It can not be compared to the more abrupt and tank-like lakes among which it lies, though it may possibly have with them a common origin in subsidence, similar but less violent.



THE REMARKABLES, LAKE WAKATIPU. IN THE FOREGROUND IS SEEN THE FRANKTON ARM.

Waikare and Whangape are so shallow as to rank rather with swamps than with lakes, in spite of their considerable area. The interest of the former lies chiefly in its peculiar relation to the Waikato river, a relation which enables it to reduce the harmful effects of floods, though not lying on the river's actual course.

SHORTER ARTICLES AND DISCUSSION.

CHARACTERISTIC CURVES OF COMPOSITION.

In the June number of this journal there appeared an interesting article by Dr. Robert E. Moritz, on 'The Significance of Characteristic Curves of Composition,' mostly devoted to an examination and criticism of some conclusions stated by me in a paper published nearly twenty years ago and practically applied in another paper published in 1901. To those who have had enough interest in this somewhat curious application of the doctrine of chance to read all of these papers carefully no comment upon or reply to the criticism of Dr. Moritz need be addressed, but in these piping times everybody is so busy preparing his own papers for the press that he has time only to glance at the results of the intellectual activity of others, and it has become a common, indeed, almost necessary habit to make a hurried hunt for the conclusions of scientific investigations of a subject a little out of one's own field and to accept them when found for lack of time to do otherwise. For this reason I will invite attention to one or two facts having an important bearing upon the question at issue.

The assumption of Dr. Moritz is that the form of what I have called the characteristic curve of a composition, plotted as first described twenty years ago, will depend more on what he calls the *form* of composition (character, as to subject matter, etc.) than upon any personal peculiarities of the author. He believes this, the *form* of composition, 'to be the predominating factor overshadowing all others' and that 'conclusions regarding the authorship of spurious or disputed writings based upon a comparison of the word curves of work differing either in form of composition or in other essential respects must be considered worthless.' After (not before) making these and other equally sweeping assertions, he sets forth the evidence by which he believes they are supported. The principal part of this evidence is an exhibition of results of a series of 'word-countings' of various authors which he has made, from which results he deduces the conclusions quoted above.

Unfortunately these conclusions are of no value whatever because the observations on which they are founded are totally inadequate and, indeed, are specifically 'ruled out' in the very beginning by the author himself in a quotation from my earlier paper. In this it was declared that a count of '100,000 words would be necessary and sufficient to furnish the characteristic curve of a writer,' and yet, in the face of this statement, Dr. Moritz proceeds to make his sweeping deductions from groups including 1,000, 5,000 (generally) and in the case of one author two groups of 15,000 words each! He puts the curves of the two latter, including only 30,000 words in all, by the side of the Bacon-Shakespeare diagram which includes 600,000 words (not less than 100,000 being 'necessary') and then makes the charming comment upon the latter that, 'instead of furnishing a convincing proof or even contributory evidence, leaves the problem of disputed authorship wholly untouched!' In this case the value of the evidence depends on some power higher than the first of the number of words, but even if directly proportional it would be twenty in favor to one against, and it is difficult to believe the author serious in condemning so positively and confidently the evidence of a 'characteristic curve'

when he is so very, very far from ever having made one. But serious he seems to have been and perhaps never more so than when he declares that the 'average word length alone . . . would, in general, be indicative of the nature of the curve.' This is equivalent to saying that the form of a curve is known when its mean ordinate is known, and is a statement which, to those who are accustomed to the graphic representation of variables, will betray an almost immeasurable unfamiliarity with problems of this kind. Among other evidences of this state of mind which might be cited, the construction of a 'typical word-curve of extreme light dialogue'—from a count of 5,000 words from Swift's 'Polite Conversation'—is not the least convincing. To produce this Swift's curve is 'corrected' by the suppression of certain words of seven or eight letters, for no assigned or imaginable reason, except that perhaps Dr. Moritz thinks that Swift ought to have known better than to have used them. The curve of this expurgated edition of 5,000 words from Swift is interesting in form, but if it be the 'typical word-curve of extreme light dialogue' in the English language, as declared by Dr. Moritz, those who have dabbled, even a very little, in word-counting of modern comedy and humorous story writers will be saddened by the thought that the art of composing 'extreme light dialogue' must have long ago become extinct.

It seems impossible to avoid the conclusion that Dr. Moritz, perhaps as a result of a somewhat hasty examination of the subject, has failed to grasp in its entirety the fundamental principle on which the whole doctrine (if so dignified a term may be used) of 'characteristic curves of composition' is based, and a brief exposition of its most important propositions may not be out of place.

The notion that every author, however voluminous, must necessarily be restricted in his use of words to a vocabulary which would remain sensibly constant after his productive period had been reached, which, in its character and extent would be one of the personal 'qualities' of that author and thus offer a means of identification, is due, as is stated in the paper of twenty years ago, to Augustus De Morgan, who suggested that vocabularies might differ so much among different authors as to make it possible to differentiate them by means of the simple average number of letters in a word. In making some tests of this proposition it immediately became evident, as might have been anticipated, that vocabularies might differ indefinitely and enormously and at the same time agree in average word-length. The scheme for the graphic display of variations in the average frequency of occurrence of words of different lengths, as explained in the papers under discussion, was then devised and proved to be a vastly more powerful means of revealing peculiarities in composition. As to the value of this method of treatment, which is the one original feature of the whole, there seems to be no question, as even my critic has paid me the highest compliment in his power in making continued and apparently confiding use of it. The point at issue is, rather: Was De Morgan right in assuming that the personal element enters into the vocabulary of any author to such an extent as to furnish a means of identifying his writing? He evidently believes that it played so large a part as to determine the average length of words used; the theory of 'characteristic curves' implies that personality may determine *the way in which words are used* rather than their average length, and it furnishes a method for revealing peculiarities, *such as persist in the long run* (this is the kernel of the thing) in the relative frequencies of words of different numbers of letters, syllables, etc., of sentences of different lengths or of any 'qualities' that may be treated numerically. Because of simplicity, ease

of application and probable greater certainty of result, the element of word-length was that to which attention was first given. Besides, there is in this another important advantage which will be presently explained.

Now, in spite of an oft-quoted assertion to the contrary, words are used to express ideas, and the particular words used will depend largely, perhaps most largely, on the idea to be expressed; but they will also depend on the person to whom they are addressed; on the conditions under which they are spoken (as in private conversation, public address, etc.) or written (in correspondence, for publication in newspapers, journals or books); especially on the age or period in which their author lived; and perhaps on a thousand other things; but in any or in all of these cases they are determined *by the person who uses them*. The theory assumes that by combining a *sufficiently large number* of verbal expressions of any author, variations due to these thousand and one causes may be eliminated and that due to the personality of the author, the only one in fact which is common to them all, may stand revealed.

Moreover it is clear that in selecting from many personal idiosyncrasies of an author that which will best serve for purposes of identification, it will be wise to choose one *of which he is himself unconscious*, for this would most certainly persist and prevail in everything he wrote, never being either shunned or encouraged. While an author will often give thought to the arrangement of words and sentences and to other features of composition, he will almost never stop to consider the number of letters in the words which he uses, and, therefore, such personal peculiarity as may be shown by word length frequency curves is almost certain to be persistent.

Dr. Moritz is quite right in his belief that 'form of composition' (subject matter, etc.) affects very powerfully the form of a word-curve, seeming, at first, to conceal the element of personality, just as in the physical world local, near-at-hand causes seem in their effects to overshadow and conceal those of remote but more constant origin.

But it must never be forgotten that they only conceal, they do not destroy; they may over-shadow, but they can not obliterate. The position of a freely suspended magnetic needle does not, at first sight, appear to be in any way related to the phases of the moon, but a very long series of observations reveals this relation very clearly and certainly, although local happenings affect it to a much greater degree and apparently conceal the more persistent influence of a more remote cause. It is the constancy of this influence, the fact that it is present all the time, which makes it possible to differentiate it from others, often exceeding it in magnitude, but less regular in operation. And so it is *in the long run* that the personal peculiarities of an author, especially the unconscious peculiarities, will be revealed, and the so-called 'characteristic curve of composition' was suggested as a means of developing and displaying one of them.

The question under discussion includes, therefore, two parts: First, *does* the personality of an author enter into his composition so as to affect its purely mechanical aspect in a way of which he is quite unconscious?—and, second, does the 'characteristic curve' furnish a means of exhibiting such peculiarities of composition if they exist? It is not likely that anybody, after a little reflection and investigation, will be willing to say 'no!' to the first, although few people fully recognize how steadily and surely one is influenced by a bias of which one is totally unconscious. Although such unrecognized influences are often very feeble, their very persistency, the fact that they 'never sleep,' may give them so large a place in the final summing up of any series of operations that they determine the distinctive character-

istics of the operator and give 'personal quality' to the work itself. About twenty-five years ago, being much interested in problems of this kind (more than at the present moment), I spent many 'odd' and generally otherwise unusable quarter and half hours in pitching a stick into the air and noting whether it fell across any of a series of parallel lines drawn on a plane surface upon which it dropped. This cheerful occupation was continued until the stick had been thrown 20,000 times, and then the number of times it had fallen upon a line was compared with the number indicated by theory. It so happens that according to theory this experiment ought to determine the value of that important constant, the ratio of the circumference to the diameter of a circle, and in the present instance it promised for a time to do this in a most satisfactory manner. Indeed at the end of about 12,000 throws the value of 'π' was determined correctly to three decimal places and nearly correctly in the fourth. But from this time on the graphically constructed line of the experiment began to depart very slightly but very persistently from the line of theory and continued to do so to the end. The explanation was easy, it being evident that the operation which was intended to be purely mechanical was not so. There was present an unconscious personal element which interfered with the regularity of the work, to a very minute degree, it is true, but the effect of which became manifest when the *run was long*. The deviation was due to a, perhaps, very rarely occurring error of judgment in determining a single fact of the experiment, but in the long run these errors leaned towards one side, and this was beautifully revealed in the graphic exhibit of the whole series. I do not recommend the process as a means of determining errors of this kind, for it is altogether too laborious, and besides, I have not found it necessary, kind friends having generally kept me well informed as to my errors in judgment.

What I want to illustrate and emphasize is the importance of my being *unconscious* of this bias, which otherwise would have destroyed the value of the whole experiment. It is the 'unconscious touch' which most surely identifies personality in any artistic performance. It is likely that Raphael never meant to paint two Madonnas alike, indeed it is likely that he would generally make some effort to have each different from all that he had done before, but all have something in common, unsuspected by the artist but known to the expert and furnishing a practically sure means of identification. Moreover, these unconscious technicalities of an artist, the key to identification, are most frequently known and utilized by persons who have little knowledge and less appreciation of the real artistic qualities of the works which they compare (see Ruskin on the identification of old masters), the operation being the more certain as it is more purely mechanical. It is within the memory of most of those who will read this that the result of a national election together with the whole character and policy of the national government narrowly escaped being determined by the skillful introduction of a single phrase of only three words into a letter which afterwards proved to be a forgery. So characteristic of the alleged author was this phrase that at first even those who knew him best were reluctant to deny its authenticity. And yet I have excellent reasons for believing that the distinguished statesman whose splendid career was thus imperilled was entirely unconscious of the uncommon frequency with which this phrase occurred in his speaking and in his writing. It is because the scheme of the 'characteristic curve' lends itself to the development in a purely mechanical way of idiosyncrasies of which the author must be unconscious that it is thought to have some value as a means of identification. It may be that this as-

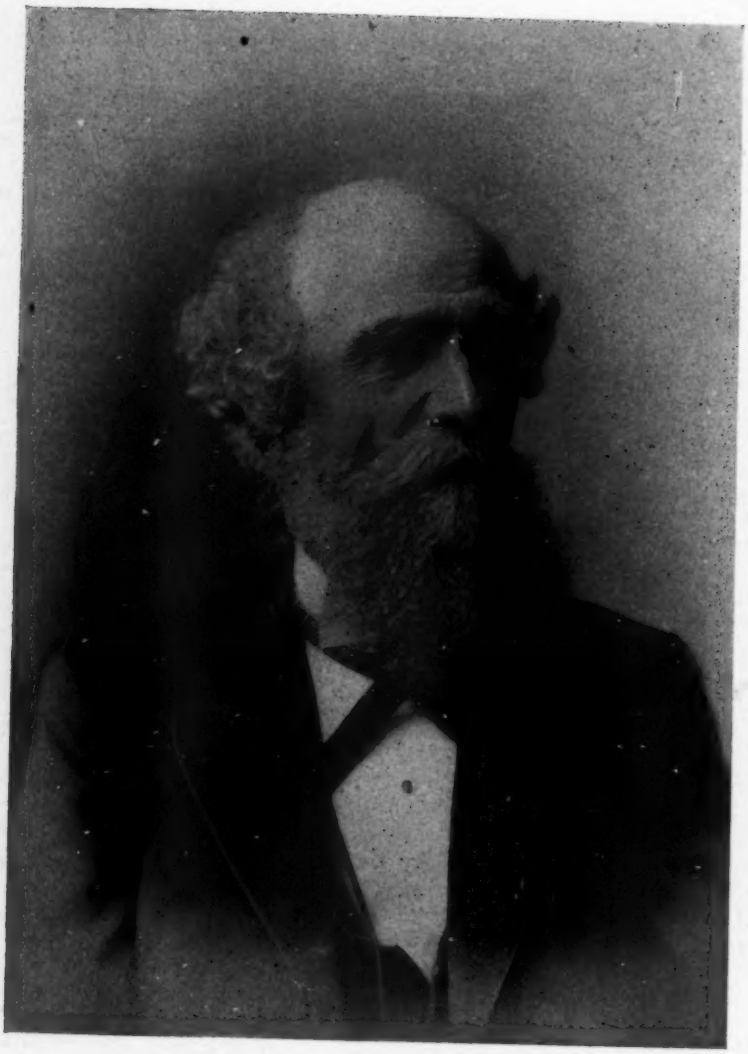
sumption has not yet been proved, but in view of what has been said and even of what was said twenty years ago, it can not be said to have been disproved. If instead of making deductions from groups of 1,000 to 5,000 words, Dr. Moritz had declared his belief that even 100,000 was too small a number for a perfectly definite characteristic curve the statement would have been well worth consideration; but it is difficult to doubt the evidence of diagrams exhibiting the word curves of several of the principal writers of Shakespeare's time, published in this journal, December, 1901, nearly all of which are based on counts of over 100,000 words each, and especially the very remarkable agreement, amounting to practical identity of the two curves from Shakespeare, each including about 200,000 words; the almost equally close agreement of two curves of 75,000 words each from Ben Jonson; and the striking difference between the latter and the curve of Shakespeare, although the 'form of composition' is the same in both, a fact directly opposed to Dr. Moritz's conclusion from a few groups of 5,000 words each.* After the reader has examined the close agreement of these large groups from the same author, he may consider the contrasted curves of Bacon and Shakespeare, representing the counts of over a half million words, and, as far as I am concerned, he is still 'at liberty to draw any conclusion he pleases.'

Dr. Moritz's studies of the influence of 'form of composition' on the word curve are instructive and it is to be hoped that he will have the patience and courage to continue them. When his word counting, instead of including only a few thousands, shall have reached a million or two, and these of not more than a half dozen authors, what he may have to say upon the subject will be listened to with interest.

T. C. MENDENHALL.

FLORENCE, ITALY,
June 24, 1904.

*It is interesting to compare diagrams 8, 11 and 14 of his paper, to note the *general* agreement of the two curves for each author, the general and, indeed, striking differences among the three authors (which would have been much more evident in *means* of the several pairs) and to inquire if he has even correctly interpreted his own diagrams?

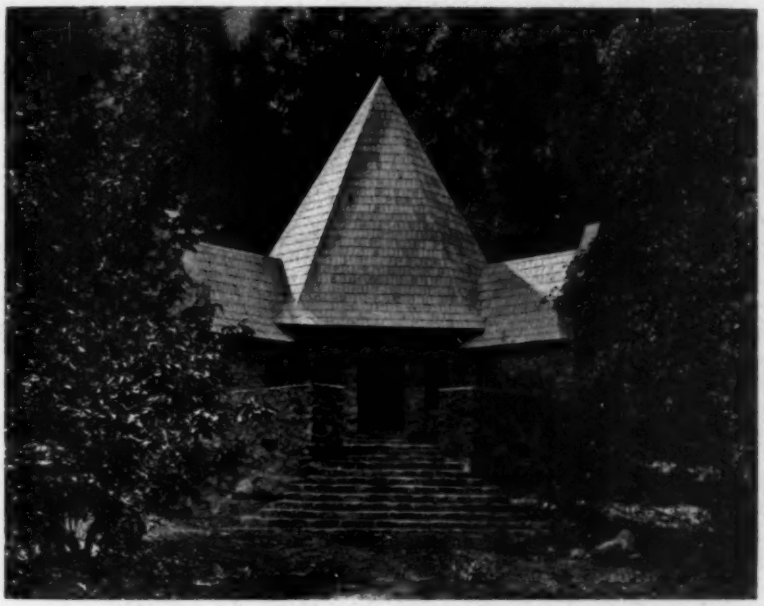


Very truly yours
Jerome LaCanta

THE PROGRESS OF SCIENCE.

THE LE CONTE MEMORIAL LODGE.

JOSEPH LE CONTE died in the Yosemite Valley in 1901, and a memorial lodge has now been erected there in his honor by the Sierra Club. As the illustrations show the lodge is built in a manner appropriate to its beautiful surroundings. The stonework is of granite obtained in the vicinity with the weathered surface exposed, and the interior roof beams are uncovered. The main reading room is 36 x 25 feet in size. The lodge is overshadowed by the great cliffs of Glacier Point; there is a fine grove of trees in the rear, and the entrance commands a magnificent view. The structure was designed by Mr. John White and erected at a cost of about $5,000, subscribed by Le Conte's students, colleagues and friends, and members of the Sierra Club. It is most appropriate that there should be erected to Le Conte a memorial of this character, in this region that he loved so well and where he died, not a mere monument, but a building useful in promoting the out-of-door interests and scientific pursuits, which in his life time he greatly forwarded.



THE LE CONTE MEMORIAL LODGE. Photographed by Hallett-Taylor Co.

There has recently been published by the Appletons an autobiography of Le Conte which, though written only as a manuscript for his family, presents a pleasing account of an interesting and lovable man, who held an important place in the scientific life of the country for more than fifty years. Joseph Le Conte was born on a Georgia plantation in 1823. His father was a scien-

INTERIOR OF THE LE CONTE MEMORIAL LODGE. Photographed by Hallett-Taylor Co.

tific man though he did not publish his work. His uncle, John Le Conte, was a naturalist, whose son, John Lawrence, was an eminent entomologist. His brother was a prominent physicist. A nephew is one of our leading physicists, and his son is a scientific man. Joseph, John and John Lawrence Le Conte were all members of the National Academy of Sciences, whose membership has included approximately only the two hundred leading American men of science of the past half century. We have here a very clear case of scientific heredity or family tradition.

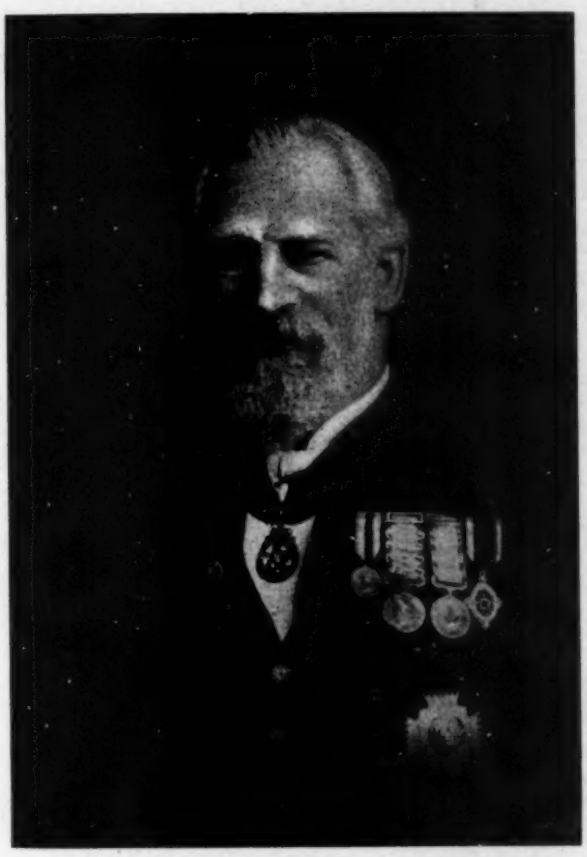
Le Conte belonged to the type of scientific man that can scarcely survive under the conditions of modern specialization. He taught practically all the sciences, including mathematics, with French added. He made contributions to geology, zoology and psychology, and wrote much on the theory of evolution and the relations of science to religion. We can not here undertake to give an account of his life, not in itself eventful but covering a wide field and a long time, touching the south, the north and the west. We must refer readers to the autobiography for an account of the life and life-work of a single-minded and truly great man.

SIR WILLIAM FLOWER.

FLOWER was one of the notable group of naturalists who gave distinction to Great Britain during the second half of the nineteenth century. He can not be ranked with Darwin, scarcely with Huxley, but his contributions to comparative anatomy and to museum administration were of the highest importance. Five years after his death a memoir has been prepared by Mr. C. J. Cornish with the cooperation of his son and of Lady Flower. The title page states that the work is 'a personal memoir.' In view of this explicit statement it would perhaps be unfair to criticize the book for paying more attention to Flower's high character, his beautiful family life, his christian faith and his relations with the nobility than to his contributions to science and

to the scientific development of Great Britain during the Victorian era. A life of Flower or of one of the other scientific leaders of the period written on the lines of Mr. Morley's great 'Life of Gladstone' would certainly be more valuable to the world than a personal memoir. While we have no right to demand such a biography from Mr. Cornish, we may regret that the memoir is from the scientific side superficial and even inaccurate. For example it is recorded in the title page that Flower was 'Late Director of the Natural History Museum, and President of the Royal Zoological Society.' Flower was in fact director of the Natural History Department of the British Museum and president of the Zoological Society of London.

Flower was born in 1831, his father being a brewer of Stratford-on-Avon, who spent his youth in America. As has been the case with many scientific men, Flower's early education was irregular; he was as a boy devoted to natural history, learning to stuff birds at the age of ten and establishing a 'museum.' He secured a medical education at University College, London, and served as a surgeon in the Crimean war. He married in 1858 the daughter of Admiral W. H. Smyth, an astronomer, one of whose sons became eminent as an astronomer and one as a geologist, while a daughter married the



Sir William Flower, K.C.B.

Savilian professor of geometry at Oxford. Flower's family life with his seven children was particularly happy. At the age of thirty he gave up the practise of surgery to become conservator of the museum of the Royal College of Surgeons. Here he remained for twenty-two years until in 1884 he succeeded Owen as director of the Natural History Branch of the British Museum whose new building in South Kensington had been opened two years before. This position Flower held until his health failed in 1898.

During these years Flower published volumes on the osteology of the mammalia and on other subjects and a great number of special papers on comparative anatomy and zoology, on anthropology and on museum administration. Only three years after the publication of the 'Origin of Species' he arranged the collections of the Hunterian Museum to illustrate and as it were make tangible the doctrines of evolution. One of the steps in this direction consisted in obliterating the demarkation between recent and extinct forms. In many ways Flower made improvements in museum methods which have been followed everywhere. He had wide interests and filled many positions of trust and honor. Thus he was president of the Zoological Society of London from 1879 until his death in 1899.

GEOLOGICAL PHOTOGRAPHS.

Mr. Osmund W. Jeffs, in 1889, advocated the formation of a collection of geological photographs, and the committee of the British Association with this object in view was formed the following year. Mr. Jeffs acted as secretary of the committee until 1896, when he was succeeded by Professor W. W. Watts, and work has been carried forward actively, the number of photographs numbering 3,754 in 1903. In 1899 plans were made for the publication of a series of platinotype prints and lantern slides to be distributed to subscribers, and three issues containing seventy-two photographs have been issued. These photographs are accompanied by descriptions by well-known geologists and are of much scientific and educational value. We reproduce here two of the photographs.

The Whin Sill, Teesdale.

Mr. E. J. Garwood thus describes the Whin Sill, Hugh Force, Teesdale: This is a classical waterfall, described by Sedgwick in 1823, Wm. Hutton in 1831 and Phillips in 1836. The fall is 70 feet high, over the Whin Sill, which is here intrusive in the Lower Yoredale Beds. The photograph shows the chief fall near the right bank of the Tees. It is working along a joint in the hard Whin which forms the protective cap to the fall; when in flood surplus water also pours through a second joint near the left bank. The undercutting of the limestone is shown by the caves and the hanging icicles; the gorge below bears testimony to the recession of the falls. The section is as follows: Whin sill, 30 feet; shale, thinning out, 2 feet; whin, 9 feet; shale, altered, with superinduced prismatic jointing, 15 feet; hard limestone, with pyrites, 8 feet; hard, fossiliferous, crinoidal limestone, 20 feet; coralline limestone, 6 feet. The limestone is altered and saccharoidal to a distance of 35 feet below the base of the whin; the latter is of the normal type described by Teall.

Mr. W. A. E. Ussher gives an account of the natural arch at Torquay: The natural arch depicted in the photograph forms a conspicuous object on the south coast of the Torquay Promontory between the Bath Saloons and Daddy Hole. It has been tunneled by the sea through a small headland near the axis of an inverted synclinal curve in Middle Devonian Limestones. The prolongation of this axis eastward is well shown on the coast a quarter of a mile away. In the middle and lower part of the limestone masses of Torquay, a partial cleavage is often displayed by the beds, consequent on the pressure which has produced the folding in them; this structure, as shown in the photograph, becomes in certain cases most pronounced at and near the axis of the folds, causing a shattering of the rock at the point where the direction of strain cleavage approximates to, or coincides with, the inverted bedding planes. The dark marking extending

NATURAL ARCH AT TORQUAY.

horizontally on either side of the arch in the photograph denotes high water mark. The railings give a scale.

SCIENTIFIC ITEMS.

We record with regret the death of Dr. John Bell Hatcher, curator of vertebrate zoology at the Carnegie Museum, Pittsburg; of Dr. N. S. Davis, of Chicago, a voluminous writer on medical subjects and chairman in 1845 of a committee whose report led to the establishment of the American Medical Association; of M. Anatole de Barthélemy, the eminent French archeologist; of M. Léauté Sarrau, professor of mechanics in the Polytechnic School of the University of Paris, and of Dr. Fedor Bredichin, professor of astronomy at St. Petersburg.

Dr. W. H. Maxwell, superintendent of schools in New York City, has been elected president of the National Educational Association.—Dr. Louis S. McMurtry, of Louisville, Ky., has been elected president of the American Medical Association for the meeting to be held next year at Portland, Ore.—Professor George Darwin, of Cambridge, will succeed Mr. Balfour, the British premier, as president of the British Association, and will preside over the meeting to be held in South Africa next year.

Professor Simon Newcomb, U.S.N. (retired), has been elected corresponding member of the Berlin Academy of Sciences.—The honor of knighthood has been conferred on Professor James Dewar, the chemist, by King Edward.—The new chemical laboratory of the University of Utrecht, named in honor of Professor J. H. van't Hoff, has been formally opened. On the occasion Professor van't Hoff was given the honorary doctorate by the university.

President E. A. Alderman, of Tulane Univeristy, has been elected president of the University of Virginia. The University of Virginia, in accordance with the democratic ideas of Jefferson, has hitherto been governed by a board of visitors and the faculty without a president.—Dr. Charles Schuchert, of the U. S. National Museum, has been appointed professor of historical geology in the Sheffield Scientific School of Yale University and curator of the geological collections in succession to the late Professor Beecher.—Dr. Roux has been elected director of the Pasteur Institute in the room of the late M. Duclaux. Drs. Chamberland and Metchnikoff have been elected subdirectors of the institute.

At the alumni dinner of the State University of Iowa, the former students of Professor Samuel Calvin, to the number of over two thousand, united in the commemoration of the completion of his thirtieth year in a professorship at that institution. The recognition took the form of a costly silver loving-cup, designed especially for the purpose of symbolizing the scientific achievements of the recipient. The cup is a classic Greek vase, sixteen inches in height, and stands on a base of serpentine five inches high. It is adorned with casts taken directly from fossils, with a drainage-map of Iowa, with crossed geological hammers, a microscope, and the more conventional spray of laurel, owl of wisdom and torch of learning,—all in relief. One side bears an appropriate inscription in raised letters. Professor Calvin was elected to the chair of natural history in Iowa's university thirty years ago. The chair has since been subdivided into four distinct departments. Professor Calvin retaining the department of geology. He has been state geologist of Iowa during the last twelve years.